
CHAPTER SIX

ENVIRONMENTAL

CONSEQUENCES

6. ENVIRONMENTAL CONSEQUENCES

6.1. Introduction

The potential environmental consequences of the proposed channel improvement alternatives require analysis of a substantial number of topics, including those of local, regional and national concern. The length of the proposed channel improvement, in excess of 100 river miles, and its nature, operation, and maintenance of a 40- to 43- foot channel in an area with a rich tradition of natural resources, contribute significantly to the number of project-related issues to be addressed. The proposed improvements include in-water and upland disposal actions, which have a substantial bearing on the environment. Fisheries resources of the Columbia River are a management concern at the national level and the proposed improvements occur in an area critical to the recovery and sustainability of their populations.

Specific impact areas addressed in this chapter result from years of maintenance dredging of the river and associated environmental evaluations and field studies; coordination with resource agencies and the public in that process; and the scoping, public meeting, and workshop process conducted for this feasibility study with integrated EIS. Major impact areas addressed include upland disposal impacts on habitat, particularly wetlands and riparian habitat; impacts of dredging on river hydraulics and sediment movement potentially affecting fish habitat; potential effects of dredging and disposal on endangered salmon and steelhead stocks; effects of ocean disposal on commercial fishing activities; potential release of contaminants from dredged sediments; salinity intrusion resulting from dredging a deeper channel; cumulative impacts of dredging and disposal; secondary impacts resulting from larger ships, new port developments, and dredging at port docks. For each alternative and environmental topic, conclusions have been reached as to the level and nature of any potential impact and the rationale supporting the conclusions.

6.2. Physical Impacts

6.2.1. No Action Alternative

The no action alternative would continue the maintenance of the existing 40-foot navigation channel as described in the DMMP (Corps of Engineers, 1998). The plan uses a combination of upland, in-water, and ocean disposal. An estimated 42 mcy of material would be disposed of in-water, in either flowlane (41 mcy) or beach nourishment (1 mcy) sites. There would also be about 8 mcy of ocean disposal. There would be 18 upland disposal sites, covering a total of 1,165 acres (table 4-1). Upland disposal (28 mcy) would be concentrated in the Longview-Kalama reach. No new disposal sites are proposed for this alternative. Shoreline erosion would continue to occur along the sandy beaches created by past disposal actions. The impacts of the no action alternative are described in the DMMP Supplemental EIS (Corps of Engineers, 1998).

6.2.2. 43-foot Channel Deepening Alternative

Dredging the 43-foot channel would disturb the riverbed and alter sedimentation. The increased channel depth could impact water surface elevations and salinity intrusion. Disposal of additional dredged material would require more land for disposal sites. Ships with deeper drafts might generate larger ship wakes. In comparison to the no action alternative, the 43-foot channel deepening alternative would require as much as 20 mcy of construction dredging, 12 mcy of additional maintenance dredging, and the use of four new upland disposal sites (236 acres) and one gravel pit under the proposed disposal plan. Maintenance dredging practices would shift from primarily in-water (flowlane) disposal to upland disposal. These impacts are discussed in more detail in the following sections.

6.2.2.1. Riverbed and Sedimentation

The amount of disturbance to the riverbed and sedimentation processes would vary with the amount of dredging in a reach. In the navigation channel, the total depth of dredging including 5 feet of AMD would increase from -45 feet CRD for the existing 40-foot channel to -48 feet CRD for the 43-foot channel. The depth and width of the dredging cut would vary with location. A few short reaches (CRMs 3 to 5, 36 to 37, 49 to 51, and 52 to 54) would not require any dredging. In other reaches (CRMs 22 to 36 and 68 to 74) dredging would be limited generally to areas along the edge of the channel. Nearly the entire navigation channel would need to be dredged in some reaches, such as at CRMs 10 to 13, 15 to 17, 38 to 39, 43 to 48, 63 to 68, and 88 to 97.

After the initial dredging, the riverbed would begin to adjust to the new channel depth. The riverbed adjacent to the deeper cuts may begin to degrade as bedload is deflected down the cut slope and into the navigation channel. This process of side-slope adjustment could continue for several years until the side-slopes reach equilibrium with the channel hydraulics. The depth of the bed degradation would vary; from equal to the depth of the dredge cut at the edge of the cut, to near zero some distance away from the cut.

The distance away from the dredge cut at which degradation becomes imperceptible would be highly variable. Observed degradation has depended on the local channel geometry, proximity of pile dike fields and the bed material. Some examples of the observed distances to the limit of degradation in unprotected, sandy reaches are over 2,000 feet to the north near CRM 12; about 1,600 feet south at CRM 22.5; about 1,500 feet north at CRM 46; and over 1,000 feet south at CRM 75. In areas protected by pile dike fields, the degradation has been limited, such as 800 feet north at CRM 42, 400 feet east at CRM 72, and 300 feet west at CRM 99. Future side-slope adjustments could be expected over most of the channel length and would impact the same areas as past adjustments.

Shoreline Erosion. Shoreline erosion depends on balance between erosional forces, such as river currents, wind waves and ship wakes, and the resisting forces such as the beach slope, material types, distance to the navigation channel, and degree of erosion control. The 43-foot channel could result in changes to two of those forces, the riverbed side-slopes and ship wakes.

The riverbed outside the dredging cutline tends to degrade as material moves to refill the cut. This side-slope adjustment would be most rapid near the cutline, where the post-dredging side-slope is greatest, and would decrease with distance from the cutline. Just outside the cutline of the proposed 43-foot channel, the side-slope adjustment could cause a three-foot deepening of the riverbed. The side-slope adjustment decreases with distance from the channel and would generally result in less than one foot of deepening of the riverbed near the shore. The side-slope adjustments could impact some of the sandy beaches created by past dredged material disposal. Given the range of sandy beach slopes found by Abbe (1990) of 0.10 to 0.02 feet per foot, a one foot change in riverbed elevation at the shoreline could result in 10 to 50 feet of lateral shoreline erosion on sandy beaches at former beach nourishment disposal sites. The natural shoreline of the Columbia River has been very stable for the past 100 years and would not be expected to change because of a deeper channel. The side-slope adjustments would not occur in the hard silt/clay or rocky material of the natural shorelines.

Deeper draft ships would be expected to generate slightly larger wakes, assuming they maintain the same speeds. A ship drawing 43 feet would generate a wake about 10 percent larger than the same ship drawing 40 feet if it could maintain the same speed. However, the greater mass and hydraulic resistance associated with the deeper draft would likely cause the ship to slow down, which would reduce the wake size. The overall erosion impacts caused by a few larger waves would be impossible to predict with certainty. Individually, the larger the wake the more its potential for erosion. However, river stage, flow velocity, beach geometry, beach material, and distance from shore to the ship also would influence the amount of erosion actually occurring from a ship wake in the river.

Long-term beach erosion could be more or less than under the no action alternative, and would be the summation of erosion caused by ship wakes, wind waves, and river currents. In the only study of ship wake erosion in the Columbia River (Abbe, 1990), it was estimated that ship wakes could only account for 4 to 24 percent of the total erosion observed at the Puget Island disposal site. Given this estimate of total ship wake erosion, the effects from increased draft on a limited number of ships would be insignificant. The impacts of a few larger wakes could be partially offset by the reduction in the total number of ships transiting the river.

Sediment Budget. The 43-foot channel would not be expected to change the overall sediment budget. Suspended sediment would be unchanged, with most of the estimated average of two mcy per year being discharged into the Pacific Ocean. The direction of bedload transport could be altered in areas with heavy dredging, but the total transport would be about the same as without a deeper channel. Since the closest deepening work is six miles upstream of the mouth, the net bedload transport would be unchanged at the mouth of the river.

6.2.2.2. Water Surface Elevations

For a given discharge, the depth of flow in a channel would be determined by the slope, size and shape, and material of the riverbed. Deepening a channel often lowers the water

surface elevations along that channel. The water surface reductions are generally proportional to the increase in the cross-sectional area of the channel.

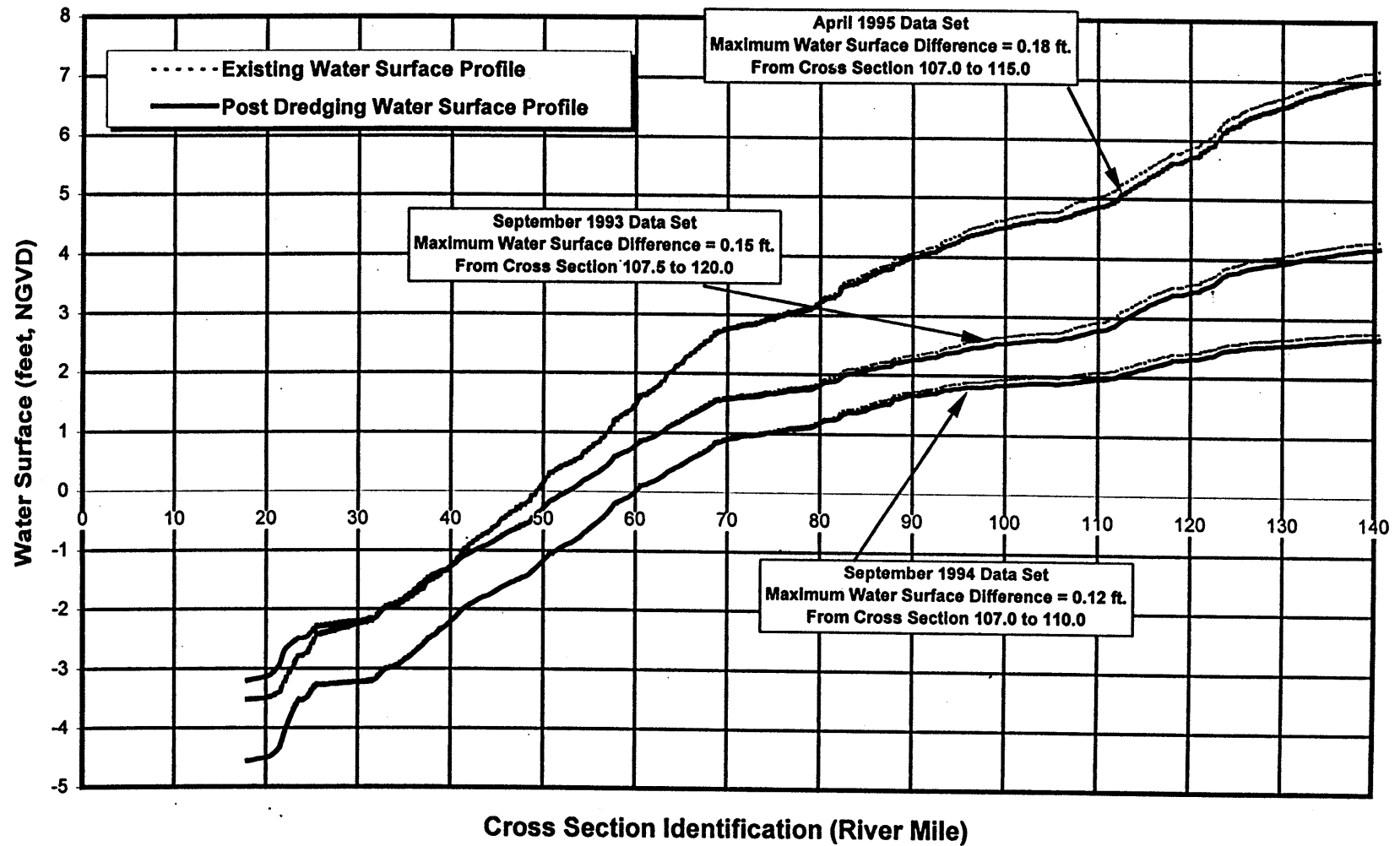
A one-dimensional, unsteady flow computer model was used to estimate the changes in water surface elevations that could occur with a 43-foot deep channel. The model analysis concentrated on low to average flow conditions. The main concern expressed during public and resource agency meetings was the potential exposure of shallow shoreline areas.

The flows used in the model were September 2 to 11, 1994, with a Bonneville Dam release of about 80,000 cfs; September 3 to 11, 1993, with Bonneville releases varying between 75,000 to 140,000 cfs; and April 3 to 13, 1995, with Bonneville releases between 140,000 and 210,000 cfs. The model was calibrated to observed stages at Skamakawa (CRM 33.5), Wauna (CRM 42.0), Longview (CRM 66.5), and Vancouver (CRM 106.0).

After calibration, the channel geometry in the model was modified to reflect future channel conditions. The navigation channel was deepened to 48 feet and some allowances were made for side-slope adjustments. The model was then rerun for each flow condition and the results are plotted in figure 6-1. The with- and without-project water surfaces show no measurable changes downstream of CRM 70 and a maximum reduction in water surface of less than 0.2 feet. The time series plots of river stage show that the reductions in water surface elevations caused by the channel deepening are much smaller than the tidal variations or the differences due to different flows.

The lack of any water surface elevation reductions downstream of CRM 70 would likely be the result of the existing large cross-sectional flow areas, main channel plus estuary and side channels, and the limited amount of channel modifications. Only CRMs 38 to 39, 43 to 48, and 63 to 68 would be heavily dredged. Upstream of CRM 70, the river is more confined to the main channel, with only small side channels, and the dredging impacts would be greater. The channel from CRM 88 to 100 is especially heavily dredged. The flat slope of the river, with less than an 8-foot drop in 100 miles also contributes to the small changes in the water surface profiles.

Figure 6-1. With- and Without-Project Water Surface Profiles



6.2.2.3. Salinity

One of the environmental concerns of the proposed improvements to the Columbia River navigation channel is the potential effect that deepening could have on salinity (salt water) patterns in the Columbia River estuary and on the distributions and abundance of estuarine organisms. Because of the density of the salt water, salinity concentrations are higher at the bottom of the navigation channel than at the surface or in adjacent shallow areas. A deeper channel extending upstream from the mouth could, therefore, cause increased salinity intrusion.

Three salinity workshops were held with state and federal resource agencies to determine the effects of channel improvement on the salinity in the estuary and the subsequent impacts to estuarine organisms. The Corps' Waterways Experiment Station (WES) conducted numerical model studies that predicted changes in salinity in the estuary. A biological consultant assisted in evaluating the biological impact as a result of the physical change in salinity. It was decided that sedentary organisms, such as benthic macroinvertebrates and vascular aquatic plants, would be more susceptible to short-term salinity changes than more mobile species such as fish. The criterion for measuring impacts to these species would be a comparison of the maximum expected salinity modeled to their known salinity tolerances. Appendix F, *Salinity Intrusion Studies*, provides more detailed information concerning the salinity studies.

A combined 2- and 3-dimensional unsteady flow computer model was used to evaluate the potential changes in salinity concentrations. Because the potential changes in salinity concentration are more important than the absolute salinity concentrations, it was agreed that the model could be validated to existing data and would provide adequate results for the evaluation. The model was validated to salinity conditions published by the CREST (Jay, 1984). Low flows of 120,000 and 134,000 cfs were used to evaluate the changes in salinity intrusion. The with- and without-project salinity concentrations along the channel are shown in figure 6-2. The salinity concentration increases predicted by the model for the 43-foot channel were small. The largest salinity increases were around one ppt along the bottom of the navigation channel between CRM 15 to 25. The predicted salinity increases near the surface of the channel and in the shallow areas outside the channel were regularly much less than one ppt.

Potential impacts to benthic organisms were evaluated at 10 sites incorporating three habitat types – intertidal, shallow subtidal, and channel bottom. These sites were located within the tidal-fluvial zone of the estuary, which is the region between CRM 20 to 30 that is characterized by relatively uniform, low salinity conditions. Potential impacts to vascular aquatic plants were investigated at five sites within the tidal-fluvial zone of the estuary. Eleven species of aquatic plants were selected for analysis of salinity tolerances and were chosen based on the availability of information on vascular aquatic plant distributions. Nine species are common and dominant in assemblages throughout the tidal-fluvial zone, and two occur infrequently.

Figure 6-2. With- and Without-Project Salinity Concentrations

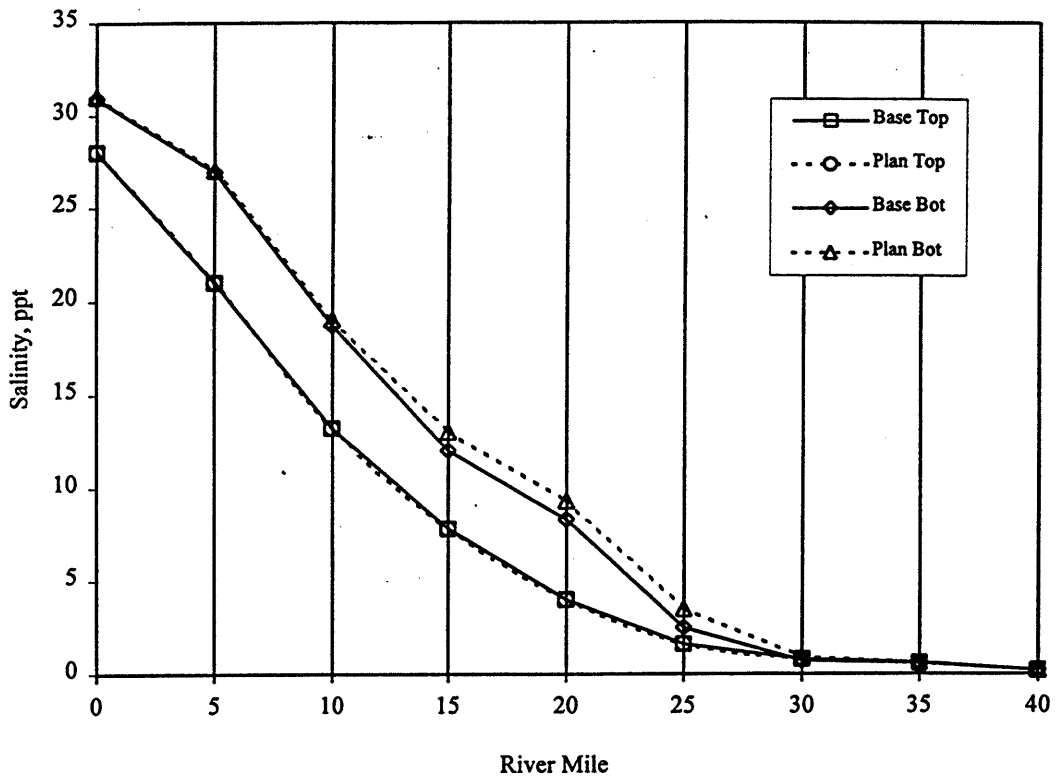


Figure Key:

- Base Top – Existing channel conditions, top half of water surface column
- Base Bot – Existing channel conditions, bottom half of water surface column
- Plan Top – 43-foot Alternative, top half of water surface column
- Plan Bot – 43-foot Alternative, bottom half of water surface column

Workshop participants reached consensus concerning study results and impacts to benthic macro-invertebrates and vascular aquatic plants, as discussed below.

Impacts to Benthic Macroinvertebrates

- ◆ Small increases in bottom water salinity of less than 0.5 ppt due to planned channel deepening would be predicted at intertidal and shallow subtidal sites.
- ◆ Short-term increases in bottom water salinity of up to 2.45 ppt due to planned channel deepening would be predicted at channel sites.
- ◆ Changes of this magnitude could permit short, up-channel range extensions by salinity-dependent species such as *Eohaustorius estuarius* and *Corophium brevis*.
- ◆ *Corophium salmonis*, a microscopic amphipod that is an important food item for salmonids, would likely remain the numerically dominant species at most sites, including channels.
- ◆ No impact of fish food resources would be expected.

Impacts to Vascular Aquatic Plants

- ◆ No significant effect on species examined in the present analysis is expected to result from a 0.5 ppt maximum increase in salinity in the Columbia River estuary.
- ◆ Of the species selected for analysis, wapato (*Sagittaria latifolia*), water parsnip (*Sium suave*), skunk cabbage (*Lysichitum americanum*), and rush (*Juncus oxymerus*) reflect the species with the high sensitivity to changes in salinity.
- ◆ It is likely that factors other than salinity are affecting plant species distribution in the Columbia River estuary.
- ◆ Although species of *Sium suave*, *Sagittaria latifolia*, and *Juncus oxymerus* exhibit a higher degree of sensitivity relative to other species in the analysis, they often occur in habitats typified by salinities that exceed the individual species salinity tolerance and therefore, are likely distributed along another gradient (elevation, substrate).

Overall, workshop participants reached consensus and accepted the following statement:

No significant biological impact would result from salinity changes predicted for the proposed channel deepening.

6.2.3. Proposed Disposal Alternative

The proposed disposal plan for the 43-foot alternative is the sponsor's preferred disposal plan, summarized in table 4-19. Disposal actions will occur in-water throughout the length of the channel, at three beach nourishment locations, at new and previously used upland locations, and offshore in the ocean.

6.2.3.1. Upland Disposal

The proposed disposal plan would use 29 upland disposal sites with a total area of 1,681 acres. Fourteen of these upland sites, totaling 1,025 acres, were included in the no action alternative. Fifteen upland sites were not included in the no action alternative. Two sites from the no action alternative were enlarged by a total of 41 acres when used for the proposed disposal plan. Four sites in the proposed disposal plan (W-101.0, W-96.9, W-62.0 and W-44.0) contain agricultural lands and encompass 236 acres.

6.2.3.2. In-Water Disposal

The amount of in-water (flowlane) disposal used during maintenance of the proposed 43-foot channel would be less than that used to maintain the existing 40-foot channel. Most of the shift from in-water to upland disposal would occur upstream of Longview. The deeper channel and the higher volumes of maintenance material limit the utility of in-water disposal upstream of Longview.

The greatest use of in-water disposal would be between CRMs 27 and 42 because there are few upland disposal options. Nearly 2.5 mcy of dredged material would be placed in-water in this reach during construction, and an additional 12 mcy would be disposed of

during the 20 years of channel maintenance. The maintenance disposal would be about a one third increase over recent maintenance disposal rates in this reach. Nearly half of the proposed in-water disposal in this reach would occur between CRM's 29 and 32, with the remainder spread throughout the reach. Over the 20 years, this disposal could raise more than 400 acres of the riverbed in and around the disposal areas by as much as 20 feet. The actual changes in bed elevations that occur will depend on factors such as the total area used for disposal, the volumes disposed, and the amount of material transported away from the sites by the river. Some of the impacted area could be between 65 and 130 feet deep.

6.2.3.3. Ocean Disposal

The ocean sites receiving final site designation will receive dredged materials transported by either government or private contractor hopper dredges or dump barges. Current hopper dredges or dump barges available for use have hopper capacities ranging from 800 to 6,000 cubic yards. This would be the volume range of dredged material deposited in any one dredging placement cycle. The 4 mcy estimated to be removed annually from the MCR can be placed at the sites in one dredging season by any combination of private and government plants. The dredges or barges would be under power and moving during disposal, allowing the maintenance of steerage.

Materials dredged for offshore disposal traditionally came from shoals forming at the MCR. They consist primarily of marine sand transported into the entrance. The material is clean, contain no contaminants of concern in excess levels, far removed from known sources of contaminants, and acceptable for unconfined open-water disposal. Material proposed to be dredged from the Columbia River navigation channel (CRMs 6 to 29) for operation and maintenance purposes and possible channel deepening have been evaluated and found acceptable for unconfined open-water disposal.

These sediments consist of sands with low percent of silts and clays or organic material. Some fine-grained material from side channels or backwater areas may be placed offshore in the future which will require testing and evaluation. Exhibit C of Appendix H provides detailed results of sediment analysis performed on material to be dredged and the sediments at the candidate sites.

6.3. Water Quality Impacts

Navigation channel dredging and in-water and ocean disposal would not result in significant water quality impacts. Dredging could result in a short-term elevation of chemicals and a decrease in dissolved oxygen at the dredge and disposal sites. Short-term turbidity increases (cloudiness of the water caused by suspended particles) would also be expected from in-water disposal actions. Turbidity measurements were conducted at a beach nourishment site and at an in-water (flowlane) disposal site in the Columbia River. Additional monitoring was conducted at Morgan's Bar during placement of material dredged from the Willamette River. Most material was found to settle rapidly to the bottom with minimum suspension of sediment. This also was true for the fine-grained material from the Willamette River placed at Morgan's Bar.

Background turbidity levels upstream of the disposal site prior to disposal were measured at 3.55, 3.28 and 3.10 NTUs (nephelometric turbidity unit, a unit of measure for turbidity levels in water). Many readings were subsequently measured below this level during disposal site turbidity monitoring. A minimum turbidity reading of 1.82 NTU was recorded while a maximum of 14.38 NTU was recorded. A reading of 12.38 NTU was recorded from water noted to be discolored washing around the front of the open scow while the disposal scow turned to return after disposal. The scow had not yet closed the hopper. This was the only station where water was visibly discolored on the surface. The area affected was minimal and the effect transitory. No other significant discoloration was noted on the surface during or after discharge of the dredged material.

Turbidity induced by dredging and dredged material discharge in the Columbia River appears to be limited and transitory in nature. Compared to natural fluctuations in suspended sediment levels, dredging induced turbidity would be a minor constituent to the Columbia River system.

Although the Columbia River is water quality limited for temperature, bacteria, dissolved oxygen, total dissolved gas, toxics, arsenic, and pH, the proposed project is not expected to cause or contribute to exceeding criteria for temperature, bacteria, pH, or total dissolved gas. Although the proposed project may cause short-term local decreases in dissolved oxygen, it is not anticipated that these minor reductions would contribute to dissolved oxygen concentrations that exceed the applicable water quality criterion. Dredging and disposal activities, as proposed, should not contribute to exceeding criteria for toxics and arsenic because, as discussed above, sediment screening and testing in the navigation channel indicates these chemicals are not present in navigation channel sediments.

Ocean disposal impacts would not be expected to have any impact on the water quality in the ocean. No significant contaminant or suspended solids releases are expected. Based on previous work at the MCR project (see Exhibit C of Appendix H) disposal of fines should not have any long-term impact on the water quality. There should be no water quality impact to known limited resources. Section 404(b)(1) and Section 103 evaluations prepared to address water quality effects of considered actions are included in Exhibit D.

6.4. Sediment Quality Impacts

6.4.1. Navigation Channel

Sediments in the Columbia River portion of the navigation channel are primarily sand with low percent organic content and would be suitable, based on EPA and Corps criteria, for unconfined in-water and upland disposal. Because these sediments meet the exclusionary criteria of the CWA and the MPRSA, no further testing would be required for the Columbia River. The dredging and disposal of Columbia River material would have no significant impact on sediment quality in the ocean, river or in the upland disposal sites.

The material routinely dredged for maintenance of the Willamette River portion of the navigation channel has continually been found suitable for unconfined in-water disposal.

However, some material in the Willamette River which has not been dredged for more than 20 years has been found to be potentially unsuitable for in-water disposal. These include the east side of the channel at WRM 10.3 and a small area downstream of the Broadway Bridge at WRM 11.6. Channel deepening would require the dredging of contaminated sediments as identified in Appendix B, *Columbia and Willamette River Sediment Quality Evaluation*. Only chemical and physical evaluations have been conducted on these sediments as part of this study. If areas were to be dredged that exceeded chemical screening levels, biological testing of this material would be conducted. If the material does not indicate an adverse biological effect the material would be determined to be suitable for unconfined in-water disposal. Additional testing may not be required if other dredged material disposal management practices are utilized.

Management practices for contaminated sediments could include no dredging, upland disposal, or capped in-water disposal. If contaminated sediments are not dredged, these sediments would remain in-place and may constitute a degraded or potential remedial condition. No upland disposal sites have been identified along the Willamette River at this time. Capped in-water disposal has been used for contaminated sediment successfully throughout the United States including the Willamette River. Subaqueous capping is the controlled, accurate placement of contaminated dredged material at an appropriately selected in-water placement site, followed by a covering (cap) of suitable isolating material. Based upon final project design (PED phase), it is expected that additional testing and evaluation of material proposed to be dredged along the Willamette River channel would be performed prior to dredging. Design of suitable confined disposal sites or treatment of the contaminated material would be required. Overall the sediment quality impact to the Willamette River would be beneficial, by removal and isolation of contaminated sediments harmful to the aquatic environment.

6.4.2. Ocean Disposal

Material dredged from the federal navigation projects usually consists of medium to fine sands taken from recurring shoals. These are deposited on slightly finer continental shelf sands. Because of their coarse nature, similarity to disposal site sediments, isolation from known existing or historical contaminant sources, and the presence of strong hydraulic regimes, dredged sands from the shoals meet criteria for exemption from further testing according to provisions of 40 *Code of Federal Regulations* 227.13 (b).

6.5. Hazardous, Toxic, and Radiological Waste Impacts

6.5.1. No Action Alternative

All disposal sites considered for use in the DMMP (Corps of Engineers, 1998) were investigated, and none were found to have HTRW contamination.

6.5.2. 43-foot Channel Deepening Alternative

The CERCLA and state clean-up sites adjacent to the navigation channel may be undergoing remedial actions under federal or state authorities, and may contain contaminated sediments that extend into the channel. If dredging were to encroach on these remedial actions, coordination with the regulatory agencies and property owners would be necessary to avoid impacts. The study performed a qualitative evaluation of the potential impact to these sites.

For the lower Columbia River, dredging in the navigation channel does not encroach on any known sites with ongoing remedial activities. There are several sites along the shoreline that have contaminated sediment concerns. Most of these sites are more than 1,000 feet from the channel and would not likely be affected by any of the alternatives.

Within the lower Willamette River, there are numerous sites under investigation or remediation that have contaminated sediment concerns. Many of these sites are adjacent to the current channel. The EPA and the Oregon Department of Environmental Quality (ODEQ) are currently studying sediment quality along a 5.5 mile stretch of the river in the Portland Harbor, which has a history of highly developed industry. Numerous sites line the river bank in this area and are under investigation or remediation for contaminated substances. These sites include:

Time Oil Co. Northwest Terminal
Linnton Oil Fire Training Grounds
Gould, Inc.
Port of Portland Terminal 4
ARCO Bulk Terminal
Mobil Oil Bulk Plant
Time Oil Linnton Terminal
Port of Portland - Ship Repair Yard
Willbridge Bulk Fuel Area (Chevron,
Shell, Unocal)

McCormick and Baxter Creosoting
GATX Facility
US Moorings Corps of Engineers
Elf Atochem North America
Rhone-Poulenc, Inc.
Riedel Environmental Services
Gunderson, Inc.
GASCO

Numerous studies and data have accumulated regarding these sites. Near-shore sediments in the reach are generally characterized by fine and coarse grained sediments contaminated with a variety of compounds. Major contaminants of potential concern include PAHs; pesticides including 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, and disulfoton; the metals arsenic, cadmium, copper, lead, tin, mercury, nickel, zinc; volatile organic compounds; petroleum fuel compounds; dioxins/furans; and PCBs. The level of these compounds is far greater in the near-shore sediments than in the sediments found in the navigation channel. Studies to date tying specific site contaminants to sediments found in the navigation channel have not been conclusive. There are also other potential sources of contamination along the Willamette River, but no comprehensive study is available. There are no HTRW concerns associated with ocean disposal.

6.5.3. Least Cost and Proposed (Sponsor's) Disposal Alternatives

Disposal of dredged material is proposed for 30 upland sites in the least cost disposal alternative. The proposed disposal alternative would encompass 29 upland disposal sites and one gravel pit. Three wildlife mitigation sites (Woodland Bottoms, Martin Island and Webb) are also included in each disposal alternative. Most of these sites were evaluated for impacts by existing contamination, and the potential for sediment disposal to impact contaminated properties adjacent to the sites. Other sites received an initial screening but were eliminated from consideration for other reasons.

The Corps has been required to evaluate HTRW impacts on project lands since 1992. Historic information on dredged material indicates that sands placed on upland sites are not contaminated. There is no evidence that placement of material at upland sites in the past has adversely impacted existing, nearby HTRW sites.

Most upland disposal and wildlife mitigation sites considered were evaluated for HTRW contaminants. The condition of previously disposed material on sites has been reviewed and has not contained contaminants of concern. Proposed disposal material has been sampled and the quality of that material is discussed in Section 5.1.7. Based on the history of dredged material management and the low potential for contaminants in the sandy Columbia River sediments, continued placement of dredged material on a site which was previously used would not likely add contaminants of concern to the site.

Water added to the site may potentially drive existing groundwater contaminant plumes toward groundwater wells or temporarily change the local groundwater gradients. For the instances where there are nearby groundwater contamination issues, site owners and regulatory agencies were consulted. For the sites selected for this study, and based on these consultations, no existing contaminated sites appeared to be adversely impacted by use of the disposal sites.

Sediments to be placed in upland disposal sites have been evaluated, and none are expected to be contaminated. Except on the lower Willamette River, sediments in the navigation channel are coarse sands and free from regulated quantities of hazardous constituents. Sediments from the lower Willamette that are impacted by chemicals would be evaluated for unconfined in-water disposal under the CWA.

Preliminary assessment screenings (PASs) were conducted for most of the disposal and wildlife mitigation sites proposed in the disposal alternatives. One disposal site (W-44.0, Puget Island Vik Property) was added to the project recently and not evaluated. One other small site (W-95.7) was not evaluated, although adjacent disposal sites were evaluated. The Webb wildlife mitigation site at CRM 47.0 has also not been evaluated. The intent of the investigation is to limit the disposal and mitigation sites selected to only those sites that have no contamination, or identify those sites that may need additional investigation and possibly cleanup prior to their use. Complete assessment screenings for disposal and wildlife mitigation sites included in the least cost alternative can be found in Appendix E, *HTRW Preliminary Assessment Screening*.

A PAS is an initial survey of a property prior to real estate acquisition or easement for disposal rights. For each site, a description of the physical property, its condition, observed potential contamination or contaminant sources, topography, and surroundings is provided. Current and past land uses are described, and the uses of neighboring properties, where relevant, are summarized. Relevant land uses include those having known contamination that could affect the site, and those having contamination or use (e.g. drinking water wells) that may be affected by use of the property.

The site assessment also includes a review of historical documentation including aerial photographs; a review of regulatory listings and, if necessary, review of site files; site visits; and interviews with regulators, site owners and tenants where available or necessary. Regulatory lists reviewed included:

- ◆ EPA Lists: CERCLIS and the NPL
- ◆ Oregon Lists: Underground Storage Tank Facilities, Underground Storage Tank Cleanup, Environmental Cleanup Site Information
- ◆ Washington Lists: Underground Storage Tank, Leaking Underground Storage Tank, Confirmed and Suspected Contaminated Sites, Hazardous Sites

A PAS was prepared for the sites to determine the potential for contamination on-site and the potential for disposal to affect contamination on adjacent sites. The paragraphs that follow summarize the results of the PAS reports for each site and describe the reasoning behind any recommendation for additional study. The following sites have the greatest potential for contamination issues related to their use as dredged material placement sites.

O-105.0, West Hayden Island. The Port of Portland owns this undeveloped site in Oregon. Portions of the site have been used for dredged material disposal in the past, and much of the site would be developed. The Port has investigated the site for hazardous conditions and has completed a small tank removal and soil cleanup from its use as a heavy equipment operator school. There is a low potential for hazardous debris due to the demolition of two small farm buildings on site. This potential would be determined prior to implementation. There are no other known conditions on the site that would preclude its use for material disposal.

W-101.0, Gateway 3. This site is located in Vancouver, Washington, immediately downstream of the VANALCO aluminum reduction facility and is owned by the Port of Vancouver. Two farms presently operate on the site. Evidence of pesticide, herbicide, petroleum, animal waste, and solid waste disposal exists near the buildings of one of the farms (Egger). Shallow groundwater contamination (petroleum products) has been identified on part of the VANALCO property, but due to distance and river gradients, it is not believed to be an issue for dredged material disposal at the Gateway 3 site. An environmental baseline survey and cleanup of the Egger farm is planned if disposal occurs at that site. The current plan is to use non-wetland areas of the site for disposal.

O-94, Sauvie 94 (mitigation site). The site is located in the middle of Sauvie Island in Oregon. One farmhouse appears to have asbestos-type siding, and other farm buildings may have been painted with lead-based paint. Contamination by petroleum products and agricultural chemicals may also exist near the buildings. An environmental baseline survey is recommended if the farm buildings would be acquired. If only the fields are acquired, no additional investigation would be necessary.

O-91.5, Lonestar Gravel Pit (sponsor preferred). The site is just north of the airport in Scappoose, Oregon, and is currently mined by Lone Star Concrete. A site visit and possibly an environmental baseline survey are recommended if the equipment storage yard and abandoned solid waste landfill near the two gravel pits would be acquired. If the mine remains in current ownership and operation, no additional investigation would be necessary.

O-90.6, Scappoose Dairy. The site is located near the Multnomah Channel near Scappoose, Oregon, and is currently used for grazing, dairy and growing hay. Contamination from petroleum storage tanks, farm equipment maintenance, and agricultural chemicals is possible. An environmental baseline survey is recommended if land near the farm buildings would be acquired. If only the fields are acquired, no further investigation would be necessary.

O-87.8, Port of St. Helens Creosote (Railroad Corridor, sponsor preferred). The site is located at the confluence of Milton Creek and the Multnomah Channel, one mile south of St. Helens, Oregon. From 1919 to 1959, Pope and Talbot operated a wood treating facility using creosote, pentachlorophenol, arsenic, and chromium-based solutions. From 1974 until 1990, Niedermeyer-Martin leased the site and operated a log stripping facility. Waste oil was used to control dust on the site, and some may have been disposed of behind the shop. The site is on ODEQ's Confirmed Release list, and ODEQ is conducting a remedial investigation of the site. Soil and sediment contamination has been confirmed at the site. The sponsor will be required to assure that the disposal site is acceptable for use.

W-97.1, Fazio Sand and Gravel. This site is located in Ridgefield, Washington, and is currently used as a dredged material rehandling site. Columbia River dredged material is currently placed on the site and is then marketed to buyers. The site contains tanks for refueling equipment. The potential for contamination from petroleum products and equipment maintenance would require an environmental baseline survey if the property would be acquired. However, if disposal and processing at the site continues under the same ownership with no changes in management practices, no additional investigation would be required. A review of the site would occur prior to any change in practice.

W-96.9, Adjacent Fazio Sand and Gravel. The site is located adjacent to the Fazio Sand and Gravel site located near Ridgefield, Washington. Fifteen 55-gallon drums were observed, although they might have been just outside the site boundary. An environmental baseline survey is recommended to determine if these containers have impacted the site.

O-82.6, Reichold Chemical (sponsor preferred). The site is located near Columbia City, Oregon. The site is crossed by an ammonium nitrate pipeline which leads from a fertilizer plant located across Highway 30 and the railroad tracks from the site. The pipeline sits on the ground surface. Disposal of dredged material on this site will require relocation of the pipeline. Soil sampling for nitrates is recommended under the pipeline prior to acquisition of disposal rights.

O-77.0, Lower Deer Island. This site is a river bar island located downstream of Columbia City, Oregon, and upstream of Kalama, Washington. During the field examination, one 55-gallon drum with no label was observed on its side on the beach at the upstream end of the site. The contents are unknown. If the drum is still there, the contents should be sampled for proper disposal, with possible soil sampling beneath the drum to verify it has not leaked.

W-80.0, Martin Island (mitigation). Martin Island is a 350-acre island between Woodland and Kalama, Washington. The island is proposed as a wildlife mitigation site. One house (over 40 years old) and one log storage lagoon (installed in the 1980s) exist on the site. Sediments in the lagoon are likely covered with wood debris. If the site would be acquired, the house should be surveyed for lead-based paint and asbestos. Rights for dredged material disposal may be acquired without further investigation. No disturbance to sediments in the lagoon, which would raise the TOC and BOD levels in the water, is recommended.

W-67.5, International Paper Site (sponsor preferred site). This site is an active dredged material rehandling facility located landward of the levee on International Paper property in Longview, Washington. Material is conveyed by pipeline to the site. Several sites nearby have contamination concerns. Remedial actions are being monitored by the ODEQ and EPA. A 1991 RCRA facility assessment determined that wood waste beneath the disposal site was not a contaminant concern. None of the sites are affected by the current dredged material handling practice and would not be affected by continued use of the site in the future. No additional investigation is required if the current management practices on the site are continued and the boundaries of the site do not change.

W-62.0, Mt. Solo. The site is located immediately west of the Reynolds Metals plant and immediately south of the closed Mt. Solo landfill near Longview, Washington. The landfill was closed in 1991, and groundwater and surface water monitoring indicates no contamination. Monitoring will continue for approximately 13 years. A drainage ditch runs from the Reynolds property between the disposal site and the Mt. Solo landfill. The drainage ditch may be contaminated from either the Reynolds or the landfill property. The Reynolds property includes several facilities closed under RCRA. No off-site groundwater contamination migration to the west has been documented. Disposal of dredged material has the potential of mounding of groundwater driving contaminants toward the Reynolds and Mt. Solo landfill properties. Recommendations include groundwater monitoring prior to and during disposal of dredged material, a detailed evaluation of existing data and consultation with adjacent property owners, and providing a separate drainage for return water (not the existing drainage ditch).

O-54, Port Westward. The site is currently owned by the Port of St. Helens and is located on the former Beaver Army Terminal near Clatskanie, Oregon. A Portland General Electric plant, located adjacent to the disposal sites, stores hundreds of thousands of gallons of fuel oil. Seven underground storage tanks were removed from the area (outside the disposal site) by the Corps in 1993. Minor groundwater contamination was found in excavations which was determined not to be associated with Army tanks. Two Army-installed underground storage tanks remain in use by PGE on their plant. Hybrid cottonwoods for paper construction are grown adjacent to the disposal site. Drainage ditches in the area appear to be contaminated with organics from agricultural uses (tannin and iron bacteria). It is recommended that the Port of St. Helens quantify any petroleum and agricultural chemical contamination prior to placement of dredged material.

O-42.9, James River. This site may require an environmental baseline survey. The site is located on a former dredged material disposal site near the Wauna paper mill in Wauna, Oregon. The site is bottomland farmland adjacent to the river within a levee system. The adjacent paper mill has placed process sludge and other soil amendments on the site in an effort to vegetate the site after receiving dredged material. The paper mill sludge has been sampled by the mill. It is in the best interest to complete a review of the material amendments to the site and collect samples to determine a baseline condition at the site.

None of the other evaluated sites exhibit potential contamination issues from past land uses and from an HTRW assessment perspective, would be considered acceptable for material placement in their present condition. It is recommended that PASs be prepared for the five sites not previously evaluated, and that the Lower Deer Island site be visited to determine if the drum noted in 1995 is still on the site. This would be accomplished during the next phase of design (PED). There are no HTRW concerns associated with ocean disposal.

6.6. Biological Impacts

6.6.1. Aquatic Resources

6.6.1.1. No Action Alternative

The no action alternative is the existing 40-foot channel maintenance program as defined by the DMMP (Corps of Engineers, 1998). Aquatic resource impacts occur from channel dredging and shoreline/flowlane (in-water) disposal actions. Impacts are reduced by minimizing shoreline disposal and avoiding shallow and deep water flowlane disposal.

6.6.1.2. 43-foot Channel Deepening Alternative

The aquatic resources of the Columbia River would be impacted by both dredging and disposal actions associated with the channel improvement project, as discussed in the following sections.

Dredging. The channel improvement alternative involves dredging the channel deeper. Dredging will be done principally using hopper, pipeline and clamshell dredges. The principal aquatic impact of dredging would be the disruption of bottom habitat and loss of the benthic invertebrate community associated with the bottom sediment that is removed. In the channel area, these impacts are not expected to be significant since benthic habitat of the existing 40-foot deep navigation channel is generally not considered to be productive. The low productivity is due to the lack of light penetration at this depth, the higher current velocities, and the presence of unstable sand waves along most of the channel bottom. Limited studies in the deeper areas have verified lower benthic invertebrate densities at greater depths. Studies by Jones et al. (1990) and McCabe et al. (1993) have found benthic invertebrate densities in the deep areas to be a third less than in the areas from zero to 20 feet deep, which are considered to be the most productive habitat for benthic invertebrates in the Columbia River.

In addition to altering the bottom community, dredging may also result in the entrainment of fish and other aquatic organisms. The white sturgeon is a major species of concern in the Columbia River because it inhabits the deeper areas where the dredging is to be done and where sturgeon would be most susceptible to entrainment. Other species of concern are juvenile Columbia River smelt, which are carried downstream along the bottom by river currents.

Studies of entrainment of organisms by hopper dredging have occurred in the coastal area and to a lesser extent in rivers (Larson and Moehl, 1990). A four-year entrainment study was conducted at the mouth of the Columbia River by Larson (1993). This study was done aboard the Corps hopper dredge, *Essayons*, to determine the types and numbers of organisms that would be entrained during normal maintenance dredging of the entrance channel. Results of this study indicated that a variety of organisms were entrained and that some could be entrained in large numbers at certain times. Dominant species entrained included young-of-the-year Dungeness crabs, *Crangon* shrimp, and sandlance, all of which are estuarine or marine species. Entrainment rates, though varying by individual sample, were fairly consistent over the May to October dredging season, except for Dungeness crabs, which were more prevalent in the May to July samples.

An evaluation of entrainment of organisms during hopper dredging in the upriver area of the navigation channel was done using the Corps hopper dredge, *Yaquina*, in May 1997. Though the original intent of the study was to sample during dredging operations, the percentage of large grain sediment was much higher than anticipated and sampling could not be done during dredging without clogging the sampler. In finer grained sediments, the dredge material passes through the mesh in the bottom of the sample basket to the hopper while organisms and larger material are retained in the basket. The larger grain material in the upper river area did not pass through the mesh and the collection basket was filled in a matter of seconds. Increasing the mesh size in the basket was not feasible since most of the organisms would then pass through the mesh of the basket, which would underestimate the number of organisms entrained. As a result, it was decided to take samples with the dredge pumps running and the draghead just skimming the bottom. This is not representative of entrainment that would occur during dredging and would in fact over-

estimate entrainment since the suction of the draghead is greatly increased with it off the bottom. The samples would provide a reasonable estimate of organisms present near the bottom. The results showed that after taking 48 samples over five hours of pumping time, two juvenile salmon and one juvenile sturgeon were collected. The juvenile salmon were identified as recently released lower river hatchery fall chinook subyearlings. It is highly unlikely, however, that these species would have been entrained during normal dredging operations with the draghead buried in the sediment.

Hydroacoustic studies done in the lower river to determine distribution of juvenile salmon were conducted in 1997 and 1998. Results show that most juvenile salmon were located along the channel margins and therefore, would not be susceptible to entrainment (T. Carlson, personal communication, May 1999).

A single entrainment study has been completed in the Columbia River for a pipeline dredge operating in deep water near Portland at CRM 102 (Buell, 1992). Results of the study indicated that no juvenile salmon were entrained but that when the dredging was done at depths of 60 to 80 feet where sturgeon are known to be abundant, about 2,000 juvenile sturgeon ranging in size from 30 to 50 centimeters were entrained. This area was only about 20 percent of the total area dredged and no sturgeons were entrained in the other areas sampled. An estimate of the mortality of sturgeon was also done and was determined to be about 3.5 percent after passing through the dredge and into the runoff pond. This would indicate that as long as they could pass out of the disposal site through the runoff water discharge the impact may be fairly minor.

Columbia River smelt also have the potential to be entrained by pipeline, hopper or clamshell dredges. Adult smelt moving upstream are found primarily in the water column and are not likely to be entrained to any extent by hydraulic dredges. Clamshell dredges have the potential to impact adult smelt as the bucket passes through the water column. Larval and juvenile smelt move downstream on the bottom with the current and have a greater chance of being entrained or scooped up by the clamshell dredge. Larval and juvenile smelt are too small and fragile to be effectively monitored in an entrainment sampling program. Consequently, it is not known how many would be entrained by construction or maintenance dredging. Impacts to larvae and juvenile smelt, however, would be minimized to the extent possible by scheduling the dredging operation to avoid their peaks of downstream movement.

Pacific lamprey (*Lampetra tridentata*), a fish important to the Native Americans of the region, also has the potential to be entrained by dredging. Adults migrate upriver to spawning areas in the tributaries in the summer. Juveniles migrate downstream to the ocean to rear in the spring. No information is available on the entrainment rate of these fish; however, it is likely very small since none have been collected in previous entrainment studies.

Rock Removal. Rock removal would be needed at six areas in the Columbia River and two in the Willamette River. Basalt is present at three areas at CRMs 42, 56, and 87 and at two areas at WRMs 3 to 7 and 10 to 11. A softer, consolidated rock occurs at CRM 63 to 67 and at CRM 105. An area with an unknown type of rock (probably basalt) is located at CRM 101. There is a high likelihood that rock in the basalt areas was fractured during the construction of the 40-foot channel. Mechanical methods such as a large clamshell dredge would be tried to see if the rock could be removed. Underwater blasting will need to be done in areas where mechanical methods are unsuccessful. Excavated rock will be placed in upland disposal sites.

Mechanical excavation of rock areas is not expected to have any more of an impact than normal dredging operations which were discussed earlier. In the event that the rock has to be blasted, several measures would be taken to minimize the impacts. The principal impact of blasting is the mechanical damage caused to the fish's internal organs by the pressure wave produced by the explosive. If the over pressure (the pressure over the blast zone) exceeds several hundred pounds per square inch (psi), internal organs and membranes will rupture which can lead to death. The NMFS has requested that over pressures be kept at 10 psi or lower to prevent injury to listed salmonids. This level would also protect other species of resident and anadromous fish. The blasting plan followed for the work in the Columbia and Willamette Rivers would be similar to a method used in Lake Erie and New York Harbor. A considerable amount of monitoring data was collected during these two projects. Using this information, it is possible to design a blasting plan that would not exceed the 10 psi requirement.

The current plan calls for all blasting to be done during the in-water work period of November 1 to February 28 in the Columbia River and for the remainder of the year in the Willamette River. The recent listing of steelhead in the Willamette could, however, shorten this window. The contractor would drill and fill with explosive as many holes as possible during one twelve-hour shift. Each hole would contain 100 pounds or less of explosives. Each charge would be detonated on a delay so that only 100 pounds of explosive would be detonated at one time. In this way over pressures can be kept to 10 psi or less at distances of 30 to 50 feet from the blast point. Monitoring of over pressures would also be done to ensure that pressures remain below 10 psi.

In addition, measures would be employed to scare fish away prior to the blast. A variety of methods are available and all seem equally effective in moving fish away from the area. Incorporating these measures should minimize impacts to fish during blasting to the maximum extent possible. A detailed fish monitoring plan will be developed and coordinated with the state resource agencies prior to the beginning of any work. Impacts to benthic invertebrates are unknown since very little work has been done on pressure impacts on these species. It is likely that benthic communities in the vicinity of the blasting area would be destroyed. Following material excavation, however, it is expected that these communities would recover to pre-blast levels.

Shoreline, Upland, and In-water Dredged Material Disposal. Dredged material will be placed in upland areas, at shoreline sites, and in high energy deep areas along the channel margins. Impacts to aquatic habitat would occur principally by shoreline and in-water disposal. The number of shoreline disposal sites have been reduced dramatically from the 80 sites that were available prior to 1993. Reasons for this reduction include a lack of need for a large number of the sites; economics of disposal practices that made some sites unfeasible; and the ESA listing of Columbia River salmon stocks by the NMFS.

The NMFS concluded that some shoreline sites provide important habitat for migrating juvenile salmon by supporting populations of benthic invertebrates that provide a food source. They also have found that the shallow area just offshore from the shoreline sites provides escape habitat from predators and resting areas for juvenile salmonids. Consequently, in their 1993 Biological Opinion for the Columbia River maintenance dredging program, the NMFS approved only those actively eroding, coarse grain sites of least value to juvenile salmonids. Fourteen sites were listed in the Biological Opinion, and most of these have since been used on a regular basis.

Studies were done in 1994 and 1995 (McCabe and Hinton, 1996) to assess the biological productivity of 10 additional historic beach nourishment sites to determine if the NMFS would approve the addition of some of these sites. These additional sites were proposed in order to retain operational flexibility so additional capacity would be available in the event of an unusually high shoaling year. The results of the study indicated that these sites were fairly productive for benthic invertebrates and, in particular, for *Corophium salmonis*, an amphipod that is an important food item for juvenile salmonids. Mean densities of *Corophium* ranged from about 900 to 45,000 organisms per square meter for the 10 sites. Densities were generally higher at the offshore station compared to the inshore station and were also 2 to 3 times higher in April than October. None of these sites has been used for some time and the habitat has reestablished, which may account for some of the higher densities. Two of the sites were much less productive than the others, which was likely due to their erosive nature.

The use of fewer shoreline disposal sites has had a varying impact on habitat depending upon the individual site. Some sites, particularly less erosive sites, would benefit from not being used since they have stabilized and productive habitat has become reestablished. Other more erosive sites would not stabilize and could become less valuable as they erode into a steep sandbank or the original mud banks that historically occurred along the river. Neither condition would provide habitat for *Corophium* as productive as the sand beach created from shoreline disposal. Consequently, the actual impact from not using a site may range from an increase in benthic communities to a loss of habitat and reduction in population depending on changes to the site's physical characteristics over the long term.

Three beach nourishment sites, Miller Sands (O-23.5), Skamokawa Park (W-33.4) and Sand Island (O-86.2) are proposed for use. They will be used primarily for maintenance material disposal although the Sand Island site will also be used for construction disposal. These sites have been used extensively in the past and are highly erosive. Although these sites were not sampled by McCabe and Hinton (1996) as part of the beach nourishment site

evaluation, they are likely not very productive because of their erosive nature. Consequently, it is not anticipated that there would be any significant impact with their continued use. In addition, since the sites are highly erosive, it is unlikely that they would provide any productive habitat if not used, and would likely erode away to the point where they no longer provide shallow water habitat.

Flowlane disposal areas would generally occur along the margins of the channel in depths of from 50 to 65 feet. In order to accommodate the volume of material for construction of the deeper channel, however, there are several areas where disposal may occur in areas shallower or deeper than these depths. At CRM 64 to 68 and from CRM 90 to 100, disposal can occur up to depths of 35 feet. Disposal is also proposed at depths greater than 65 feet at the following five locations: CRM 5 downstream, CRM 29 to 35, CRM 39 to 40, CRM 54 to 54.3 on the Oregon side of the channel, and from CRM 72.2 to 73.2 on the Washington side of the channel. Flowlane disposal in depths from 35 to 65 feet is not expected to have a significant impact on aquatic resources. As indicated previously, benthic invertebrate productivity is generally low in the deeper channel areas and impacting these areas would not affect the overall productivity of the Columbia River.

A study of fish populations in channel areas was conducted by McCabe (1997) over four seasons and at six locations in the lower river. Results of this study indicated that these areas are used by juvenile white sturgeon and to a lesser extent by juvenile salmon and smelt, as well as a few other demersal species. Most of these species were collected in fairly small numbers during all seasons sampled. During each disposal event only a few inches of sediment would deposit on the bottom. It is expected that most fish would be able to recover from this level of sediment deposition or would move out of the area during the disposal. Small fish not able to move out of the area would likely be smothered. However, the numbers of fish collected were generally small, and it is not anticipated that losses would significantly affect the overall populations in the Columbia River. Disposal in the shallower areas, however, may disturb some salmon migrating along the channel margins. This impact is expected to be minimal since disposal at these depths would only occur infrequently.

Disposal in areas deeper than 65 feet may have a greater effect on white sturgeon populations because sturgeon are thought to occur in higher abundance at these depths (McCabe and Tracy, 1994). Disposal would be similar to that in the shallower areas and would result in only a few inches of sediment being deposited on the bottom over several minutes. As a result, it is likely that most sturgeon would be able to avoid being smothered during disposal. Some young-of-the-year and juvenile sturgeon, however, may be unable to avoid being smothered. Disposal in some deeper areas may result in these areas being filled with as much as 20 feet of material, which may reduce the amount of deep-water habitat available for sturgeon. It is likely, however, that these areas would be useable by sturgeon following disposal events. Benthic invertebrate and sturgeon studies are planned for these sites during the next phase of this study. This information will be used to assess the potential impacts of these sites and develop a disposal plan that would minimize or eliminate these impacts.

Flowlane disposal may also impact lampreys that migrate through the lower river. The extent of this impact is not known because the distribution of lampreys in the lower river is unknown. If they are near the bottom, and since they are not residing in the lower river, it is likely that they could avoid disposal operations during their migrations.

Impacts to commercial and recreational fisheries from deepening the river channel is expected to be minimal. Dredging and disposal would occur principally in areas where it occurs now and impacts would be similar to the existing maintenance program. Recreational sturgeon fishing in the vicinity of the deeper flowlane disposal areas may be the only fishery likely impacted to some extent. Disposal in these areas may cause fish to move out of this area which would make them unavailable for harvest. Increased turbidity during disposal may also cause a reduction in fishing success in these areas.

Ocean Dredged Material Disposal. Aquatic resources off the MCR are described in detail in Exhibit A of Appendix H, *Columbia River Ocean Dredged Material Disposal Sites*. The proposed ocean disposal sites have many pelagic organisms occurring in the water column over them. These include zooplankton (copepods, euphausiids, pteropods, and chaetognaths) and meroplankton (fish, crab and other invertebrate larvae). These organisms generally display seasonal changes in abundance. Since they are present over most of the coast, those from the MCR are not unique compared to the overall coastal population. Based on evidence from previous zooplankton and larval fish studies, it appears that there would be no impacts to organisms in the water column (Sullivan and Hancock, 1978).

The proposed ocean sites are located in an area that supports a variety of pelagic and demersal fish species as well as shellfish including Dungeness crab. Pelagic species include anadromous salmon, steelhead, cutthroat trout, striped bass, lamprey, smelt, herring, sturgeon, and shad that migrate through the estuary to upriver spawning areas. Juveniles of these species are present in the area following their migration out of the river or estuary into the ocean. Some remain in the nearshore area for various periods of time feeding and rearing, while others move directly offshore. Demersal species are primarily various species of flatfish.

Concerns have been raised about disposal of material on both soft and hard shell crab and juvenile flat fish. Disposal impacts were evaluated in a series of preliminary laboratory tests. Results of these tests indicate that both soft and hard shell crabs could survive disposal events up to ten inches if they moved into the water column during disposal, rather than staying buried in the bottom. Some crabs and all the juvenile flatfish tested moved into the water column during disposal. The tests were limited, however, and additional tests would be necessary to fully define this impact. The results of the tests are described in detail in Appendix H, Exhibit F. Disposal at the ocean disposal sites would result in the mortality of the benthic organisms and some of the crabs and fish that are in the disposal location. These sites have been located in areas that would minimize these impacts to the extent possible. A detailed discussion of the site selection process and impacts of the sites is presented in Appendix H.

The proposed deep-water ocean disposal site is located in an area that generally has moderate densities and number of species of benthic infauna. Areas offshore beyond the 200-foot depth contour, and in areas of fine-grained sediment such as those associated with the "mud hole" (the area where fines transported out the mouth of the Columbia River settle), have consistently higher densities and number of species. Benthic infaunal samples were collected at the locations shown in Appendix H, Exhibit A. The deep-water site is located in a transition area between the deep water and shallow water areas.

Ocean disposal would impact commercial crab fishing to some extent off the mouth of the Columbia River. Ocean disposal site E is near the navigation route that crab fisherman take to the northern fish grounds. Disposal at site E could cause navigational hazards for these boats if the depth of sediment is not monitored. A comprehensive bathymetric monitoring program is currently planned at site E to ensure that mounding would not occur. The new deep water site, though partly located in an area where crab fisherman have agreed not to fish because of tow boat use, would affect those fisherman who choose to fish in this area regardless of lost gear. Loss of resources in this area by continued disposal may also have some effect on landings in other areas. This area, however, is relatively small compared to the entire area off the Columbia River and the impact to the total population of crabs by using the deep water ocean disposal site would be very small. Other commercial fisheries occur too far offshore or in areas that would not be impacted by disposal. Recreational fishing in the off shore area of the Columbia River is primarily for salmon and bottom fish. Neither of these fisheries is expected to be impacted by the use of the deep-water ocean disposal site since these fisheries do not occur to any extent near the site.

Wetland. Wetland habitat separate from in-water and shoreline disposal sites would be impacted under the proposed disposal plan. Two locations in the proposed disposal plan contain wetland habitat totaling an estimated 20 acres: W-62.0 (15 acres) and W-44.0, Puget Island (5.4 acres). The wetland habitat at W-62.0 is subjected to livestock grazing activity. W-62.0 is zoned for industrial development. Wetland habitat at W-44.0 is associated with a drainage ditch and is grazed by livestock. The wetland sites encompassed within the dredged material disposal sites are generally degraded in nature because of drainage, tillage and/or grazing of livestock. The 15 acres at W-62.0 are in better condition based on wetland species composition and structure than the other sites but are grazed. All wetland sites proposed for impact lie landward of dikes and are not subject to flooding by the Columbia River.

6.6.2. Wildlife Resources

6.6.2.1. No Action Alternative

The no action alternative represents the DMMP for operation and maintenance of the existing 40-foot navigation channel. Impacts to wildlife associated with implementation of the DMMP for a 20-year period would be relatively minor as that plan utilizes existing dredged material disposal sites for material placement.

6.6.2.2. 43-foot Channel Deepening Alternative

Open water, unrestrained disposal areas would occur in or adjacent to the channel at water depths of 50 to 65 feet. Harrington Sump (CRM 20) is also an open water, unrestrained disposal area. Two in-water disposal locations are identified for the Willamette River, WRKE 1 and WRKE 2. Open water, unrestrained disposal occurs as localized actions scattered in time and space throughout the length of the channel in any given year. In-water disposal practices at Harrington Sump and at offshore sites are also periodic in nature and limited to a defined space. Hopper dredge and bottom-dump barge in-water disposal actions are brief in nature (a few minutes to 20 minutes in duration). Pipeline in-water disposal may occur over the course of a few days to a week-plus at a specific site.

Wildlife use of open water disposal locations is typically limited due to water depth (greater than 50 feet) present at these locations. However, substantial numbers of wildlife may occur in or adjacent to the channel in the estuary, during smelt migration or during out migration of juvenile salmonids. Foraging gulls, cormorants, Caspian terns, California sea lions and harbor seals are the principal wildlife species encountered in waters greater than 50 feet deep. These species would be most numerous in the estuarine reaches of the channel. Gulls, cormorants, sea lions and harbor seals are most abundant in the channel portions of the river during smelt migration and extend upriver farther than the estuary at those times. Seals and sea lions also extend upriver to the Portland area and occasionally further upstream, when runs of adult salmon are present. Caspian terns are most abundant from April to August during the breeding season. Their use is heaviest in estuarine waters, including the channel, and extends upriver to at least Crims Island from the colony location in the estuary. Pelagic bird species, in addition to those identified above, would be expected to occur in estuarine waters at the downstream end of the navigation channel (downstream of Tongue Point). Waterfowl use of water in or adjacent to the channel, except for some use by scoter species in the estuary would be minor.

Designated open water-ocean disposal will also be used to accommodate dredged material derived from implementation of this alternative. Marine mammals, principally harbor seals, northern sea lions, California sea lions, harbor porpoises and gray whales would forage and/or migrate through the ocean disposal area(s). Pelagic birds such as gulls, cormorants, murrelets, shearwaters and many other species would be expected to forage and/or migrate through the ocean disposal area(s). These species would be most prevalent during fall and spring migration and summer, but use by marine birds and mammals would occur throughout the year.

Impacts to wildlife from open water, unrestrained disposal practices would be minor. Some site-specific avoidance around the dredges (pipeline outfall and associated equipment, hopper dredge and/or bottom dump barges) would be expected to occur. However, disposal practices involve only a very small area of the Columbia River at any given point in time. Wildlife species are able to avoid disposal practice and therefore continue their normal activities (foraging and travel) with only very minor disruption to their normal routines. Substantial alternative acreage of open, deep water, foraging/travel areas are readily available throughout the entire project reach of the Columbia River for

wildlife using this habitat. Dredging and in-water disposal actions are seldom expected to occur when the smelt run is in the river. Channel dredging typically occurs after May although problem shoals may require attention earlier in the year. Therefore, impacts to wildlife resources that forage on smelt and are abundant during the smelt run would be avoided in all but exceptional cases.

Dredging actions associated with this alternative would be accomplished by pipeline, clamshell or hopper dredges. Dredging would occur in deep water habitat, which generally receives limited use by wildlife species. Gulls, and to a lesser extent, crows, do take advantage of foraging opportunities at the pipeline outfalls, to which they are attracted.

Impacts to wildlife from dredging actions would be negligible. Some site-specific avoidance around the dredges (pipeline dredge and associated equipment, hopper and/or clamshell dredge) would be expected to occur. However, this involves only a very small area of the Columbia River at any given point in time or locale. Wildlife species are able to avoid dredging equipment and continue their normal activities (foraging, travel) with only very minor disruption to their normal routines. Substantial alternative acreage of open, deep water, foraging/travel areas are readily available throughout the entire project reach of the Columbia River for wildlife using this habitat. Entrainment of wildlife by either a hopper dredge draghead or a pipeline dredge cutterhead is not considered to be a concern. Human activity in the immediate vicinity of both hopper and pipeline dredges is sufficient to preclude diving birds (cormorants, mergansers, murres) and pinnipeds from the immediate dredging area. Wildlife species that forage at the water surface are quite distant from the cutterhead or draghead that work along the bottom of the river.

Numerous marine mammals and sea birds occur in the area offshore off the Columbia River. These species and their habitat are described in detailed in Exhibit A of Appendix H, *Columbia River Ocean Dredged Material Disposal Sites*. Disposal at the proposed ocean sites is not expected to impact any wildlife species.

6.6.2.3. Least Cost Disposal Alternative

The least cost disposal alternative represents one of two, upland oriented, disposal options for placement of dredged material resulting from construction and maintenance of a 43-foot navigation channel. In accordance with Section 320 of the CWA, the Corps and EPA along with the affected states will develop site management and monitoring plans for upland disposal sites. These management plans would include efforts to provide environmental benefits. Development of these plans would occur following publication of the final feasibility report and EIS.

O-105.0, West Hayden Island. This existing disposal site on Hayden Island has received dredged material within the last 10 years. Portions of the site, not currently impacted by Port of Portland disposal actions, contain minor vegetation cover (pastureland). Wildlife use of the site would be minimal. The site would be completely impacted by Port dredged material disposal actions prior to implementation of this project. Therefore, project-related wildlife impacts would be minor with project use of this site for dredged material disposal.

Site W-97.1, Fazio Sand and Gravel. This site is an existing commercial sand and gravel operation. Disposal of dredged material would not impact wildlife or their habitat.

Site W-96.9, Adjacent Fazio. This site lies adjacent to the Fazio commercial operation and riverward of the dike in the Vancouver lowlands. Approximately one-half of the property was used in the past for dredged material disposal while the portion of the site abutting Lower River Road is in pasture. The former disposal portion of the area has been used and would likely be used in the future as a stockyard. Wildlife use of this location is limited given the adjacent commercial operation and stockyard operations. Some wintering waterfowl use of the stockyard may occur when feedlot operations are active. Occasional use of the pasture by hawks and great blue herons foraging on rodents and/or amphibians would be expected. Disposal actions would result in the loss of the limited wildlife habitat available at this location and the site's value to wildlife.

W-96.5, N. Dike Field, and W-95.7. These sites are 25-acre parcels of agricultural lands landward of Lower River Road and downstream of Fazio Sand and Gravel. They lie behind protective dikes and are generally not flooded. These sites are farmed annually and support row crops and cereal grains. Use by wintering waterfowl, particularly Canada geese, can be substantial at these locations. Use by passerine birds, raptors, waterfowl and other wildlife species would vary by crop grown, season of cultivation and/or amount of crop residue left in the field. Disposal of dredged material at these locations would negate most use by wildlife, as forage resources would no longer be available for use.

O-90.6, Scappoose Dairy. This site is located adjacent to Multnomah Channel near the Scappoose Airport and Lonestar gravel pits. The site covers 107 acres and comprises part of an active dairy farm. A dike abutting Multnomah Channel protects the area from annual floods. Current site use is for grass forage/hay and silage corn production for the dairy operation. Agricultural crop production at this location is attractive to substantial numbers of wintering waterfowl, principally Canada geese. Other wildlife use includes foraging by great blue herons in the grass fields and some use by passerine birds. Small mammals and amphibian species would be expected in the grass fields and along the drainage ditches. Limited duck and songbird nesting would be expected along the drainage ditches. Use by hawks and owls also occur but would be limited due to the intensive agricultural use of the land. These wildlife uses would be lost upon placement of dredged material on the site. The site contains an estimated 7.7 acres of wetlands that are either farmed for row crop production or else occur in a drainage ditch.

W-86.5, Austin Point. This site is located in the Woodland bottoms riverward of the dike and just downstream of the Lewis River mouth. This site was formed by historic disposal of dredged material. The Port of Woodland owns the site and current site use is for a heavy equipment operator's school. Wildlife habitat is limited to about a 3-acre inclusion of riparian forest at the southeast corner of the site. Some use by passerine birds, crows, raptors, small mammals, and amphibians would occur in the riparian forest at this location. Most of the acreage at this site is heavily disturbed by heavy equipment training operations and has negligible value for wildlife. Placement of dredged material would destroy the remaining riparian habitat virtually eliminating wildlife occurrence at this location.

O-87.8, Railroad Corridor. This is an old disposal site located near St. Helens. The site is currently used as a marine equipment storage yard. Wildlife habitat and use of the location is minimal. Dredged material placement would have a minor impact to wildlife.

O-86.2, Sand Island. This is a previously used beach nourishment site that is erosive. The site receives dredged material periodically to maintain the recreational use of the park area. Consequently, this site would have negligible value to wildlife because it does not provide wildlife habitat of any consequence.

O-82.6, Reichold. This is a previously used upland disposal site. A grass-forb-moss groundcover and Scots broom shrub cover have developed at this location in the absence of recent disposal. The habitat present supports wildlife species adapted to early successional stage, principally songbirds (song sparrows, white-crowned sparrows) and rodents. Some use by red-tailed hawks, northern harriers and coyotes would also be expected. Dredged material disposal at this location would destroy the existing habitat and result in the loss of wildlife resources that use the site. The overall impact to wildlife, however, would be minor.

W-82.0, Martin Bar. This is a 32-acre disposal area in the Woodland bottoms riverward of the dike. Land at this location was formed by historic disposal of dredged material. It is composed of two separate cells of 9 and 23 acres. The cell arrangement was used to avoid riparian habitat to the extent practicable. The upstream disposal cell is currently used as a cattle stockyard (23-acre parcel); the downstream cell is unused. Wildlife habitat at this location is limited to several inclusions of riparian forest. Some use by passerine birds, crows, raptors, small mammals, and amphibians would occur in the riparian forest habitat. Open areas may receive limited use by Canada geese for grazing. The bulk of the acreage at this location is heavily disturbed by cattle and has negligible value for wildlife. Dredged material placement would result in the loss of wildlife habitat and use at this location.

W-80.0, Martin Island Mitigation Site. This site is a 34-acre in-water fill at an old borrow site for Interstate 5 construction. The site would be filled with sand, capped with topsoil and developed for mitigation purposes as an intertidal wetland. Martin Island is currently used for cattle grazing, an activity which has taken place for decades on the island. The embayment targeted for mitigation habitat development is used occasionally for moorage of log rafts and is a popular destination for pleasure boats. Habitat on the island is composed of pasturelands, riparian forest and the embayment. The area is subject to flooding by the Columbia River. Wildlife use is primarily by wintering Canada geese that forage on the pastureland. Use by small mammals, passerines and raptors would be expected to occur although not in substantial numbers. An occupied bald eagle nest was discovered near this site in 1998. Through use of timing and spatial restrictions, impacts to the nesting pair of bald eagles could likely be avoided. A more detailed discussion of potential impacts to this bald eagle pair and measures to offset impacts are presented in Section 6.7.2. Disposal of material would result in the development of wildlife habitat and increased use by wildlife.

O-77.0, Lower Deer Island. This site is located on the downstream tip of Deer Island on the Oregon shore, exterior to the dike. The site is a historic dredged material disposal location with the most recent disposal occurring as beach nourishment. Habitat present at this location is a sparse, early successional grass-forb community on the upland. Wildlife use is principally limited to songbirds such as white-crowned and savannah sparrows, and Canada geese which derive limited forage resources from the location. Wildlife use and habitat will be lost with the placement of dredged material on this site.

O-75.8, Sandy Island. Acreage and configuration at this site would match the existing 30-acre confined upland disposal area constructed and used for disposal in 1997. Use of the existing footprint would negate impacts to adjacent riparian and wetland habitat present on Sandy Island. Impacts to wildlife would be negligible, as the site footprint remains identical to the area diked and used for upland disposal in 1997.

W-71.9. This site is located at the Port of Kalama just downstream of the new steel mill. It is a previously used dredged material disposal site that has very limited habitat development. Wildlife use of the site is negligible as would be project-related impacts with its use as a disposal location.

W-70.1, Cottonwood Island and W-68.7, Howard Island. These sites are dredged material disposal locations dating to the emergency actions associated with Mt. St. Helens. These sites have a sparse groundcover of grasses and forbs. Scots broom provides a moderate cover of shrubs. Pioneering cottonwoods occur in clumps and as scattered individuals and are in the sapling stage on the site at present. An estimated 20 acres of riparian habitat occur on W-68.7 and 6 acres on W-70.1. Shrub and sapling cover provides habitat for passerine birds, some small mammals, deer and other wildlife species. Some Canada goose nesting occurs at this location, with about 15 nests in 1996 (WDFW Memorandum, 1996). Placement of dredged material on these locations would destroy wildlife habitat currently developing and result in the loss of wildlife use.

W-67.5, International Paper. This site is located on former industrial land in Longview. The site contains minimal wildlife habitat and receives little use by wildlife. Impacts to wildlife from dredged material disposal would be minor.

O-67.0, Rainier Beach. This is also a dredged material disposal location dating to the emergency actions associated with Mt. St. Helens. The site has a sparse groundcover of grasses and forbs. Scots broom provides a moderate cover of shrubs. Pioneering cottonwoods are present. Wildlife use is primarily by songbirds that inhabit early successional stage habitat, such as song and white-crowned sparrows. Dredged material placement would result in the loss of wildlife habitat and use at this location.

O-64.8, Rainier Industrial. This site is on the Oregon mainland downstream of the Highway 30 bridge at Longview. Dredged material placement has occurred in recent years and borrow activities occur at this location. Riparian forest inclusions remain at this location. Those inclusions within 300 feet of the Columbia River are critical habitat for ESA Snake River salmonids and would not be impacted by disposal operations. About 8

acres of riparian forest occur at this disposal location inland of the 300-foot boundary for ESA critical habitat. This area, in addition to some sparsely vegetated, old disposal areas at this location, support wildlife use principally by passerine birds. The habitat values present for wildlife would likely be lost with placing dredged material at this site.

O-63.5. Lord Island Upstream. This site occurs on the upstream tip of Lord Island just downstream of the Highway 30 bridge at Longview. The island was formed by dredged material disposal. Riparian forest habitat has developed over much of the island since it was initially constructed. Current disposal actions occur at the upstream tip where a 28-acre diked disposal area was used in 1997. The disposal plan uses a 46 acre diked disposal facility, and about 17.5 acres of riparian forest habitat would be lost. The balance of acreage is composed of grasses and forbs with some pioneering cottonwoods. Wildlife use is more diverse because the riparian forest habitat is well established, has attained greater height and diameter at breast height, and has developed a layer of ground litter in comparison to more recently used disposal sites. Passerine bird use would entail more species and numbers than on other used disposal sites. Black-tailed deer, furbearers, small mammals, raptors, including occasional use by bald eagles, small mammals, and amphibians would be expected to use the site. These wildlife uses would be lost with the placement of dredged material on the site.

W-63.5. Reynolds Aluminum. This is an existing diked disposal facility on Reynolds Aluminum property. The site is frequently used for dredged material disposal and material is then borrowed from the location for other uses. Consequently, the site has no wildlife habitat and essentially no wildlife use.

W-62.0. Mt. Solo. This disposal site is located immediately downstream of the Reynolds Aluminum Plant at Longview. The area is protected by a dike and does not flood on an annual basis. The property is zoned for industrial development and is currently grazed by cattle; stocking levels appear light at present. The site represents a new disposal site; no previous placement of dredged material has occurred at this location. An estimated 15 acres of the 50-acre site is considered wetland habitat, and the balance is pastureland. Waterfowl, including ducks and Canada geese, herons, passerine birds that inhabit wetland and grassland habitats, small mammals, raptors, amphibians and some furbearers would use this location. Dredged material placement would result in the loss of 15 acres of wetland habitat plus pastureland. Wildlife use at this location would be reduced to negligible levels after the placement of dredged material.

W-59.7. Hump Island. This site is located immediately upstream of the county park at Willow Grove. The site is an old dredged material disposal location recently used for beach nourishment. Vegetation has become established on the upland portions of the site, which have not received dredged material for a number of years. The site has a sparse groundcover of grasses and forbs. Scots broom provides a scattered cover of shrubs. Pioneering cottonwoods are in the sapling stage in some areas. An estimated 7 acres of early successional stage riparian habitat has developed on the site. Further riparian habitat development would occur at this location if not used as a disposal site (it is not a DMMS preferred disposal site). Shrub and sapling cover provides habitat for passerine birds, some

small mammals, deer and other wildlife species. Although some Canada goose nesting occurs at this location (5 nests in 1996), all nests were destroyed by predators (WDFW Memorandum, 1996). Placement of dredged material at this location would result in the loss of existing habitat and associated wildlife use.

O-57.0, Crims Island. This 40-acre site contains virtually no wildlife habitat because it has been previously used for dredged material disposal (beach nourishment) and was recently used for upland disposal and is mostly barren sand. Disposal would result in negligible impact to wildlife as few species are expected to use the site under existing conditions.

O-54.0, Port Westward. This is a 50-acre previously used disposal site adjacent to the Portland General Electric gas turbine generation facility at the old Beaver Army Terminal. A railroad line and small rail yard bisect the site. An access road lies between the site and Bradbury Slough, a side-channel of the Columbia River. Vegetative cover is dominated by short grasses and forbs, which reflects the dry, nonfertile sand substrate. Wildlife use is also minimal because of the sparse nature of the vegetative community present. Savannah sparrows are probably the most numerous species present. Some small mammal use also occurs and resident Canada geese exert a minor presence during the spring. Habitat conditions and wildlife use would be lost with placing dredged material on the site.

W-46.3W-46.0, Whites Island. This is a 72 acre dredged material disposal site that has riparian inclusions and sparse to moderate grass-forb ground cover. Vegetative cover developed at this location in the absence of dredged material disposal on the upland portion of the site; recent disposal actions were on the shoreline. This site supports wildlife use by songbirds, foraging and nesting by Canada geese, and provides some forage and limited cover resources for Columbian white-tailed deer. Canada goose nesting is primarily associated with the high tide drift lines and scattered trees, shrubs or dense stands of horsetail rush that occur. Placement of dredged material at this location would result in the loss of existing habitat conditions and associated wildlife use. Conservation measures, based upon an agreement reached with the FWS pertaining to the no action alternative, would be enacted to seed the site post-deposition to retain grass-forb forage for Columbian white-tailed deer (see Section 6.7.2).

W-44.0, Puget Island (Vik Property). This site is located immediately upstream of the Wahkiakum Ferry terminal and interior to the protective levee on the island's perimeter. Land use is agricultural, principally grazing of cattle or forage production for livestock. Pastureland is the dominant habitat. A drainage channel with some associated wetland and riparian habitat occurs in the northwest corner of the site. An estimated 5.4 acres of wetland habitat, subject to grazing, occurs on the property. Residences and farm buildings are present. Wildlife use is principally by wintering waterfowl with Canada geese prevalent. Columbian white-tailed deer use the area for forage and cover. Songbirds that prefer early successional stage habitat, amphibians, small mammals, and several species of raptors are the other species expected to occur at this location. Dredged material deposition would destroy existing habitat and present wildlife use would be lost. Impacts to Columbian white-tailed deer and enactment of ESA conservation measures to seed the site post-deposition to offset impacts are discussed in Section 6.7.2.

O-42.9, James River. This is a previously used disposal site that has substantial grass cover as a result of James River Corporation experimental efforts with paper mill sludge. These experimental efforts have been discontinued. The site provides some habitat for songbirds and small mammals and forage for Columbian white-tailed deer. Habitat and wildlife use would be lost after placement of dredged material on the site. Conservation measures, based upon an agreement reached with the FWS pertaining to the no action alternative, would be enacted to seed the site post-deposition to retain grass-forb forage for Columbian white-tailed deer (see Section 6.7.2).

O-38.3, Tenasillahe Island. This is a previously used disposal location on the upstream tip of the island. The site has a sparse grass-forb ground cover and provides limited wildlife habitat value. Species expected to be present include song, savannah and white-crowned sparrows, and Canada geese. Use by other species is not expected to be significant due to the sparse ground cover and periodic use for dredged material disposal. Placement of dredged material would result in the loss of existing wildlife habitat and associated use.

O-34.0, Welch Island. This is a previously used disposal site. One effort to establish grasses and forbs for wildlife nesting, forage, and cover habitat was previously implemented. Stand establishment was moderately successful and foraging by Canada geese does occur. Some nesting by passerine birds, principally savannah sparrows, is also expected. Some Columbian white-tailed deer use occurs on the site although the nature and extent appear limited. Placement of dredged material would destroy the limited wildlife habitat present and reduce wildlife use to minor levels.

O-27.2, Pillar Rock Island. This is a dredged material-formed island. The site has a grass-forb ground cover on the upstream two-thirds of the island, fringing riparian habitat primarily along the south shore of the island and shrub-grass-forb cover on the downstream one-third of the island. Canada geese nest on this island, with about 33 nests in 1996 (WDFW Memorandum, 1996). Nesting by Canada geese occurs primarily in the drift lines, and where herbaceous or shrub cover is densest. Passerine bird use of these habitats on the island is also relatively high. Some small mammals are also present. Raptors, including bald eagles and red-tailed hawks, periodically use the island. Use by eagles is primarily for perching or loafing activities. The upstream two-thirds of the island was previously seeded on several occasions in an effort to provide forage and nesting cover for wildlife. Stand establishment was moderately successful and foraging by Canada geese and other wildlife use does occur. Placement of dredged material would destroy most early successional habitat such as grasses and forbs. Wildlife use of early successional habitat would also be lost. Fringing riparian habitat, principally along the south shoreline, would be retained. Retention of the fringing riparian habitat, which includes the drift line, would maintain the bulk of the nesting habitat for Canada geese.

O-23.5, Miller Sands. This existing disposal beach nourishment site supports nesting Canada geese and mallards, and a mixed nesting colony of ring-billed and glaucous-winged/western gull hybrids on its upland portions. Survey efforts in 1998 located 112 Canada goose nests on the spit and about 10 mallard nests. Waterfowl nests were typically associated with the high tide debris line-riparian fringe on the south shore of the spit.

Beach grass clumps, logs situated on the upland portions of the spit and clumps of dense herbaceous vegetation also supported goose and duck nests. Gull nests are located on the downstream tip to the spit, generally in association with beach grass clumps or the high tide debris line. The debris line-riparian fringe habitat support passerine birds. The spit is also used as a perching and loafing area by raptors, particularly bald eagles. Shorebirds occasionally use the upland portions of the spit for high tide roosts. Canada geese forage on the sparse grass-forb cover of the spit uplands. Some passerine bird foraging and nesting occurs and principal species are savannah, song and white-crowned sparrows, horned larks, and violet-green and tree swallows. The swallow species nest in cavities in drift material. Small mammal presence is minimal; nutria is the most abundant.

Establishment of vegetative cover on Miller Sands Island is a term and condition of the NMFS's biological opinion for the existing 40-foot channel maintenance. A more detailed discussion of the rationale behind vegetative cover establishment on Miller Sands Spit is provided in the discussion set forth for Rice Island. The principal reason for establishment of vegetation is to preclude Caspian terns from shifting their nesting colony from Rice Island to Miller Sands Spit in response to habitat management on Rice Island. The principal effect to wildlife of establishment of vegetation on Miller Sands Spit is as described for Rice Island. The high tide debris line-riparian fringe on the south shore would be avoided, which would retain this high value habitat. Nesting by gulls on Miller Sands Spit would not be impacted.

W-21.0. Rice Island. This is a dredged material-formed island substantially devoid of vegetation except at its upstream tip. The island currently supports nesting Canada geese with 86 nests noted in 1996 (WDFW Memorandum, 1996) and large nesting colonies of Caspian terns (10,000 pairs), glaucous-winged/western gull hybrids (1,583 pairs) and double-crested cormorants (1,221 pairs) based upon 1997 survey results (Roby et al., 1998; Roby, pers. comm., 1998). Some passerine bird foraging and nesting also occurs at the upstream end and along the north shore where some grass-forb cover and riparian inclusions are located. Principal species are savannah, song and white-crowned sparrows, horned larks, and violet-green and tree swallows. The swallow species nest in cavities in drift material. The island is also used as a perching and loafing area by raptors, particularly bald eagles. Perching occurs on poles erected for eagles, on the ground, on driftwood, and in the few trees present. Eagles briefly nested on this island in the past but shifted to Miller Sands Island where larger nesting trees are present.

The management prescription for Rice Island is currently in a state of change in response to the level of juvenile salmonid predation resulting from the presence of colonial nesting birds. The NMFS will include implementation of management measures to vegetate Rice Island as a term and condition of their ESA biological opinion for the existing 40-foot channel maintenance. Vegetation management requirements would carryover to this proposed project as an ESA term and condition.

Currently, it is proposed to initially vegetate most of Rice Island with winter wheat in the fall or winter of 1998. A pasture mix of grasses and clovers would then be interseeded into the wheat stand in late winter or early spring to establish a permanent cover crop. Wheat

would serve to protect grass seedlings until they become established; wheat, an annual, would die out after seed development in late summer. The footprint of future upland disposal operations would be treated in a similar manner. The intent of establishing vegetative cover on Rice Island is to preclude Caspian terns from nesting on the island. Caspian terns prefer a bare sand substrate for nesting activities. As part of the 1998/1999 action, alternative nesting habitat for Caspian terns will be developed on East Sand Island near the mouth of the Columbia River.

Wildlife use of Rice Island will be altered with establishment of vegetation. Tall, dense vegetative cover would preclude nesting Caspian terns, horned larks, killdeer and other species which prefer a sparsely vegetated or bare sand habitat. Use by wintering and resident Canada geese would be expected to increase substantially as forage resources would be abundant. The gull and cormorant colonies at the downstream end would be expected to remain as these species will nest in vegetation. Songbirds, such as savannah sparrows, would be expected to increase in number with establishment of vegetative cover.

6.6.2.4. Proposed (Sponsor's Preferred) Disposal Alternative

The proposed disposal alternative is similar to the least cost alternative, except that the Gateway 3 and Lonestar Gravel Pit sites replace site W-95.7 and Scappoose Dairy; Skamokawa Park has also been added to the proposed alternative (table 6-1). The following discussion focuses on the three unique sites in the proposed disposal alternative. The other proposed sites are included in the least cost disposal alternative and were previously addressed relative to their wildlife value and anticipated impacts from use.

W-101.0, Gateway 3. This is a 69-acre disposal site in the Vancouver Lowlands immediately upstream of the Vancouver Lake flushing channel. The current land use is for agricultural purposes principally cereal grain and silage corn production. The land is owned by the Port of Vancouver and is slated for industrial development. Wildlife use, particularly by waterfowl, is substantial on the 69-acre site. Wintering Canada geese are abundant on the property slated for use. Various other wintering waterfowl species also use the property. Crop rotation and residue left post-harvest influence the level of wildlife use at this location. Cereal grain stubble fields would provide cover and forage for rodents, thus attracting raptors and herons to forage in the area. Minimal cover and forage is provided by silage corn stubble, resulting in less use by rodents, raptors and herons. Disposal actions would eliminate most wildlife use at this location as vegetative cover and forage provided by harvested agricultural crops and volunteer vegetation would be lost. A bald eagle nest site was discovered adjacent to the Gateway 3 disposal location during 1998 surveys. Time and distance restrictions can be employed during the nesting season to preclude disturbance to this alternate nest location of the Bucknire bald eagle pair.

O-91.5, Lonestar Gravel Pit. This is an active gravel mining operation near the Scappoose Airport. Wildlife habitat was previously destroyed by gravel mining actions. The intensive mining activity at the location and lack of habitat within the pit preclude virtually all wildlife use.

Table 6-1. Mitigation Requirements and Site Differences Between the Least Cost and Proposed (Sponsor's Preferred) Disposal Alternatives.

Least Cost Disposal Plan	Mitigation	Proposed (Sponsor's Preferred) Disposal Plan	Mitigation
Hayden O-105.0	No	Hayden O-105.0	No
Fazio S&G W-97.1	No	Fazio S&G W-97.1	No
Adjacent Fazio W-96.9	Yes	Adjacent Fazio W-96.9	Yes
Railroad Corridor O-87.8	No	Railroad Corridor O-87.8	No
Austin Point W-86.5	Yes	Austin Point W-86.5	Yes
Sand Island O-86.2	No	Sand Island O-86.2	No
Reichold O-82.6	No	Reichold O-82.6	No
Martin Bar W-82.0	Yes	Martin Bar W-82.0	Yes
Martin Mitigation	No	Martin Mitigation	No
Lower Deer Is. O-77.0	Yes	Lower Deer Is. O-77.0	Yes
Sandy Island O-75.8	No	Sandy Island O-75.8	No
W-71.9	No	W-71.9	No
Cottonwood Is. W-70.1	Yes	Cottonwood Is. W-70.1	Yes
Howard Is. W-68.7	Yes	Howard Is. W-68.7	Yes
W-67.5	No	W-67.5	No
Rainier Beach O-67.0	No	Rainier Beach O-67.0	No
Rainier Industrial O-64.8	Yes	Rainier Industrial O-64.8	Yes
Lord Island O-63.5	Yes	Lord Island O-63.5	Yes
Reynolds Alum. W-63.5	No	Reynolds Alum. W-63.5	No
Mt. Solo W-62.0	Yes	Mt. Solo W-62.0	Yes
Hump Island W-59.7	Yes	Hump Island W-59.7	Yes
Crims Island O-57.0	No	Crims Island O-57.0	No
Port Westward O-54.0	No	Port Westward O-54.0	No
Brown Island W-46.0/46.3	No	Brown Island W-46.0/46.3	No
Puget Is. (Vik) W-44.0	Yes	Puget Is. (Vik) W-44.0	Yes
James River O-42.9	No	James River O-42.9	No
Tenasillahe Is. O-38.3	No	Tenasillahe Is. O-38.3	No
Welch Island O-34.0	No	Welch Island O-34.0	No
Pillar Rock Is. O-27.2	No	Pillar Rock Is. O-27.2	No
Miller Sands O-23.5	No	Miller Sands O-23.5	No
Rice Island W-21.0	No	Rice Island W-21.0	No
CRM 21.0	No	CRM 21.0	No
Harrington Point Sump	No	Harrington Point Sump	No
Ocean	No	Ocean	No
W-95.7	Yes	Skamokawa Park W-33.4	No
Scappoose O-90.6	Yes	Gateway 3 W-101.0	Yes
		Lonestar Gravel O-91.5	No

The pit location near the Scappoose Airport would require post-mining restoration actions to preclude waterfowl use which impact safe air operations. Disposal actions at the Lonestar site would have no affect on wildlife habitat or resources. The route taken by the pipeline used to transport dredged material to this location could impact riparian habitat. However, methods would be employed to limit impacts to minor levels.

W-33.4. Skamokawa Park. This site is a previously used beach nourishment disposal area at Skamokawa Park in Skamokawa, Washington. The beach proposed for disposal purposes abuts the park. Material placed here would be borrowed for use elsewhere. Wildlife use at this location is minimal although bald eagles are known to perch adjacent to and immediately downstream of the site. The beach is on the outside of a river bend and is erosive. No vegetation exists on the beach. Diving ducks and western grebes infrequently occur offshore of the site in the fall and winter in low concentrations.

6.7. Threatened and Endangered Species

6.7.1. Aquatic Species

Deepening the Columbia River navigation channel to 43 feet would not be expected to have any greater impact to the listed and proposed stocks of salmonids than the existing maintenance dredging program. Dredging would occur in the same shoal locations and at depths greater than 40 feet. Adult and juvenile salmon do not normally occur at these depths in any numbers. Recent studies using hydroacoustics have shown that the fish occur more along the channel margins and shallower slopes than at the bottom of the main channel. Therefore, they would not be subjected to entrainment during dredging. Studies done with the hopper dredge *Yaquina* verified this conclusion when only two juvenile salmonids were collected during 5 hours of pumping time. Samples could not be collected during actual dredging since the size of the sediment was too large to pass through the collector. Consequently, samples were taken by running the pump and skimming the draghead along the bottom. Although this is not representative of actual entrainment, it would be, in fact, a worse case situation since fish would be more susceptible to entrainment with the draghead out of the sediment.

In-water disposal impacts associated with construction of the channel improvement project would also be similar to that for the existing maintenance dredging program. Flowlane disposal would be the principal method of in-water disposal and would mostly be done in depths below which adult and juvenile salmon normally migrate. Some disposal may occur on the channel margins and this may have an impact on juvenile salmon that are migrating in these areas. The impacts to the listed and proposed salmonid stocks, however, are still expected to be minimal since this type of disposal would only occur in a very limited area. Dredged material would disperse downstream in the main channel and would also not be expected to have a significant impact on juvenile salmon rearing habitat.

Shoreline disposal will increase slightly with the channel improvement project. Two beach nourishment sites are proposed for use rather than the one proposed in the DMMP. The impacts, however, are not expected to be any more significant than the DMMP since the

additional site proposed for use is also highly erosive and currently does not provide any substantial amount of juvenile salmon rearing habitat.

Based on the above discussion, it has been determined that proposed channel improvement project would not likely cause adverse impacts any of the listed or proposed stocks of salmonids in the Columbia River. Although the Biological Assessment for this action (Exhibit H) has been submitted to the NMFS, their Biological Opinion has not been received. Their Biological Opinion will be available during the next phase of design (PED) and their opinion will be fully considered prior to the Record of Decision.

6.7.2. Wildlife Species

Twenty-two federally listed threatened or endangered wildlife or plant species occur in the project area. Biological assessments, as required by the ESA were prepared for the listed species. Determinations for individual species were carried into the biological assessment for this study from the biological assessments prepared for the DMMP (Corps of Engineers, 1998) where project features or actions were identical. Therefore, the DMMP biological assessment for whales, northern sea lions and marine turtles suffices in its entirety for this study. The DMMP should be referenced for information covering whales, northern sea lions, and marine turtles. Those species under the jurisdiction of the FWS were addressed in the biological assessment prepared for this study when the project feature or action was different from the DMMP. The conclusions from the biological assessments are summarized below. The Biological Assessments for wildlife and fish prepared by Portland District are located in Exhibit G and Exhibit H, respectively. The Biological Opinions from the FWS and NMFS have not been received; they will be available during the next phase of design (PED) and their opinion will be fully considered prior to the Record of Decision.

Marine turtles (Pacific leatherback, loggerhead, green and Pacific Ridley) are unusual visitors to the Oregon and Washington coasts. The considered alternatives would have no affect on these species or the Steller (northern) sea lion.

Disposal and dredging actions are intermittent in nature and confined to a limited area for each shoaling site. Ample habitat exists in the Columbia River estuary and offshore areas away from project-related actions for northern sea lions to forage or pursue other activities. Dredging and disposal would primarily occur in summer and early fall whereas northern sea lions are more prevalent in winter. This timing difference would also lessen the potential for any conflicts. As material to be disposed meets environmental criteria for in-water disposal established by the EPA and the Corps, no impacts from contaminants above background levels on northern sea lions are anticipated.

Six federally listed species of whales (hump-backed, right, finback, blue, sei and sperm) are rather infrequent visitors to the vicinity of Oregon coastal jetties, entrance channels and bays. Given the nature of the proposed action and low whale use/occurrence in the project area, there would be no effect to these six whale species from implementation of the proposed expansion.

Columbian white-tailed deer primarily occur from Skamokawa, Washington (CRM 33) to Port Westward, Oregon (CRM 54) inhabiting low-lying mainland and island areas in and along the Columbia River. Disposal sites at which this species may occur include W-46.0/W-46.3 (Whites Island), W-44.0 (Puget Island), O-42.9 (James River), O-38.3 (Tenasillahe Island), and O-34.0 (Welch Island). All sites identified, except W-44.0, are previously used dredged material disposal sites. Most contain negligible amounts of cover and/or foraging habitat for white-tailed deer and deer use is merely incidental. Disposal sites W-46.0/W-46.3, W-44.0 and O-42.9 do provide some foraging habitat and limited cover for white-tailed deer. Areas adjacent to these disposal sites provide substantial habitat for white-tailed deer.

Disposal on all identified sites, and particularly those sites which provide some cover and forage value for deer, would result in loss of part or all of their forage or cover values. Acreage extent of the fill at a particular site and the interval between disposal, temper the impact of disposal. These disposal sites do not represent optimum habitat for white-tailed deer. Loss of habitat at these sites, whether temporary or permanent, is not likely to adversely affect Columbian white-tailed deer. However, ESA conservation measures will be implemented to offset impacts associated with use of disposal sites W-46.0/W-46.3, W-44.0 and O-42.9. These conservation measures would entail seeding of grasses and forbs on the disposal sites to provide forage for deer. The FWS previously (letter dated February 24, 1998) concurred with the Corps determination that DMMP disposal actions were not likely to adversely affect Columbian white-tailed deer, provided that conservation measures are implemented at W-46.0/W-46.3 and O-42.9. Acquisition of approximately 112 acres on Puget Island or 120 acres in the Webb Diking District is proposed as a conservation measure to offset ESA impacts to Columbian white-tailed deer associated with use of W-44.0 as a dredged material disposal site. Riparian forest could be established at these locations to provide cover. Through either maintenance or enhancement of pasturelands on these sites, foraging habitat for white-tailed deer could be provided. Riparian forest development at these properties could occur on slightly elevated lands to provide dry land conditions for white-tailed deer during winter. Borrow material for this elevated riparian habitat would come from adjacent areas on site that would be developed as wetlands.

Aleutian Canada geese infrequently occur in the project area. The alternatives considered would have no effect on Aleutian Canada geese.

The actions considered are not expected to affect peregrine falcon, which occur as a resident, migrant and/or winter resident of the lower Columbia River area. Dredging actions may occur in the vicinity of two of the five nesting pairs. All five pairs occur on man-made structures and in areas with high human use (auto/truck traffic, industrial development and operations, and recreational and commercial boating and fishing) and have apparently habituated to the presence of man. Dredging is not considered a significant change in human activity in the vicinity of peregrine nests nor would the activity result in a direct or close approach to an eyrie. Therefore, disturbance from dredging actions is unlikely to occur and is not considered an issue. Foraging habitat and prey concentrations are not considered limiting in the project area given the presence of

large concentrations of shorebirds, waterfowl and songbirds throughout the study area. Four of the five pairs occur in urban areas. These urban areas contain high concentrations of rock doves and starlings that provide a prey resource for urban-dwelling peregrines.

Disposal operations on upland sites focus on previously used sites with low concentrations of prey species. Since dredged materials are primarily clean sands, contaminants would not be an issue. Contaminated sediments, which may be encountered in the Willamette River, would be disposed of in an approved manner to contain contaminants present and prevent their reentry into the environment. Given these considerations, it is concluded that the actions considered would have no effect on peregrine falcons.

Marbled murrelets occur in limited numbers at the mouth of the Columbia River, principally at the Columbia River bar and adjacent nearshore areas. Dredging actions would occur upstream of the mouth. Disposal actions would be typically located further offshore than this species generally occurs. As material to be disposed meets environmental criteria for in-water disposal established by the EPA and the Corps, no impacts would be anticipated from contaminants above background levels for marbled murrelets. Consequently, the proposed action would have no effect on marbled murrelets.

Disposal actions at the proposed offshore, estuarine and riverine sites are distant from habitat either occupied or formerly used by western snowy plovers. The actions considered would have no effect on western snowy plovers.

Disposal may result in occasional localized disturbance to brown pelicans foraging offshore or in the estuary. However, this species is commonly observed in and around human activities, particularly recreational boating in Oregon bays, and appears habituated to human activity. Additionally, numerous areas are available to foraging and loafing pelicans in the immediate vicinity of the proposed sites. Discharged dredged materials are suitable for in-water disposal and therefore are not considered to pose a threat to the species or organisms comprising its food chain. The actions under consideration would have no effect on brown pelicans.

There were 56 bald eagle territories located throughout the project area in 1997 (Isaacs et al. 1997). Sixty-five bald eagle territories were checked for occupancy in 1998 along the lower Columbia River. It is expected that additional territories would be established and/or discovered in succeeding years. Bald eagles, which constitute nesting pairs, are considered year-around residents of the area. The project area also supports wintering bald eagles. Garrett et al. (1988) estimated a maximum wintering population of 170 bald eagles downstream of Longview, Washington. Bald eagles are also known to winter upstream of Longview to Portland. Migrant bald eagles also are expected to occur as transients in the project area although their numbers cannot be determined.

Members of these resident pairs and eagles wintering in the area would be expected to make use of the Columbia River shoreline, associated shallow subtidal and intertidal habitats, and inland wetlands and waterfowl habitat on Sauvie Island, Vancouver lowlands, Ridgefield National Wildlife Refuge, Scappoose bottoms, Deer, Martin, Burke and Cottonwood Islands,

Trojan power plant, Woodland Bottoms, Crims Island, Wallace Island, Tenasillahe Island, Cathlamet Bay, Grays Bay, Baker Bay, Youngs Bay and Trestle Bay. The use of deep, open water habitat (navigation channel and in-water disposal sites) by bald eagles is generally considered to be minimal given distance from shoreline perches and depth of water.

This species occurs at some dredged material disposal sites and often makes use of them for loafing and/or foraging. Dredging actions, because they are confined to deep, open water habitat, seldom pose a concern for bald eagles. Occasionally, where the navigation channel runs close to shore, bald eagles may be temporarily displaced from portions of their territory where they normally forage during dredging actions. Disposal actions would only disrupt eagle foraging activities from localized areas for short periods of time. Eagles are expected to use other portions of their foraging territory and avoid the immediate vicinity of the disposal action until it is completed and the physical plant is moved to another location. Such disruptions may occur for a few days to about two weeks.

Known bald eagle nest sites are generally greater than one mile from upland sites considered in this study. Consequently, disturbance to nesting activities is considered negligible. However, additional pairs establish territories along the Columbia River each year as documented by Isaacs et al. (1997). The Corps presently funds bald eagle nest occupancy and productivity flights along both sides of the Columbia River downstream of Portland. These flights are intended to monitor existing territories and identify new territories as they are established. The information generated is then used to direct Corps dredging and other operation and maintenance activities to preclude or limit potential impacts to bald eagles. The Corps-funded bald eagle surveys will continue for the duration of the DMMP per agreement with ESA compliance requirements with the FWS.

Reproductive success, specifically young per occupied territory, for bald eagles nesting along the Oregon shore of the lower Columbia River, has been lower than the statewide average (Isaacs et al., 1997). Contaminants, particularly DDE, PCB's and dioxins have been implicated as causal factors in the lower reproductive success experienced by lower Columbia River bald eagles (Garrett et al., 1988). Dredging has been suggested as a means wherein contaminants contained within the sediments can be resuspended and thus become available for uptake by bald eagles (Garrett et al., 1988).

Contaminants, such as DDE, PCBs and dioxins, tend to attach to fine grained sediments or organic material. Materials to be dredged from the Columbia River navigation channel are typically fine to medium-grained sands with low percent fines and organic content. Contaminant loading is not considered an issue for these sandy sediments.

Two types of shoals occur in the channel. Both shoaling patterns result from active bedload movement of fine to medium grained sands with low organic content by the river's current. Cut line shoals encroach into the navigation channel from the sides with sand flowing downslope to the channel; the cut line represents the lateral boundaries of the channel where dredging (cutting) does not extend beyond. Degradation of the riverbed adjacent to sites where cutline shoals form may occur from the downslope movement of material to the navigation channel. These areas of degradation expose sandy materials that are not known to harbor contaminants.

The other shoaling feature is sand waves or more specifically, the crest of sand waves that encroach vertically into the 40-foot authorized depth of the channel. Sand waves are similar to a sand dune with the river's current providing the propulsion. The river's current is constantly moving the sand wave downstream. Material is constantly eroded from the upstream face of a sand wave and deposited on the downstream face. Therefore, the sand that forms cutline shoals or sand waves, requiring removal by dredging, is repeatedly reexposed to the water column. Consequently, any fine grained or organic material, and associated contaminants, that are present in the navigation channel would have been exposed to resuspension by natural means.

Sediments in the Columbia navigation channel do not require extensive testing under Corps-EPA criteria due to their low organic content, low percentage of fine grained materials (silts and clays), distance from known sources of contaminants (e.g., industrial sites), and the high energy environment in which they are found. Contaminated sediments, which may be encountered in the Willamette River, either would not be dredged or if dredged, managed or disposed of into a confined location to prevent their reentry into the environment. Currently, maintenance dredging actions in the Willamette River avoid sites where contaminated sediments may be a concern.

Potential disturbance to foraging bald eagles is the primary concern associated with this project. Alternative foraging areas are available to bald eagles throughout the project area, thus the disturbance issue is considered minor. The potential exists for disturbance to nesting bald eagles, but with continuation of nest occupancy and productivity surveys and management of dredge timing and location, the potential for disturbance to nesting birds can be minimized if not eliminated. Based upon existing information, dredging actions should not expose bald eagles to contaminant levels above background levels. It is concluded that implementation of the project is not likely to adversely effect bald eagles. It is concluded that implementation of the project is not likely to adversely effect bald eagles provided conservation measures are implemented. These conservation measures include funding of annual occupancy and productivity surveys along the lower Columbia River by the Corps and implementation of time and distance restrictions to preclude disturbance to nesting pairs.

The proposed action would occur in areas that do not represent habitat for Oregon silverspot butterflies. Therefore, the alternatives would have no effect on the Oregon silverspot butterfly.

Howellia occurs in vernal pools or similar wetland areas; neither of these habitats is present at the disposal sites considered. Although the historic type locality for this species is Sauvie Island, no population currently has been found on Sauvie Island. The only known population in the general area occurs at Ridgefield National Wildlife Refuge. Therefore, disposal would occur at sites where this plant is not known to occur. The alternatives would have no effect on Howellia.

The nearest known population of golden Indian paintbrush to the project area occurs in Vancouver. Habitat for this species in the Willamette Valley was well drained, xeric, prairie sites. The populations in Washington occur in gravelly soils overlying bedrock. Disposal sites under consideration are dissimilar to the habitats required by this species. The disposal practices being considered would have no effect on golden Indian paintbrush.

Bradshaw's lomatium inhabits wet to semi-wet, native prairie habitats. The disposal sites under consideration do not provide suitable habitat conditions for the species. It is concluded that there would be no effect on Bradshaw's lomatium.

Nelson's checkermallow is scattered throughout the Willamette Valley and occurs at other locations in Oregon and Washington (CH2M Hill, 1993). Nelson's checkermallow primarily occurs in open, sunny areas with little or no shade, and the species does not tolerate encroachment of woody species (FWS, 1994). Threats to the plant's populations include agricultural land conversion, stream channel alteration, plowing, deposition of fill or yard debris, and intensive roadside management (FWS, 1994). The species occurs in a variety of habitats, such as relatively undisturbed seasonal wetlands, annually mowed roadside ditches, margins of cultivated fields, and high meadows in the Coast Range (CH2M Hill, 1993). Examples of habitats where the species has been located include:

- ◆ Hummocks in seasonal wetland habitat;
- ◆ Meadow habitat dominated by grasses and forbs, including fallow fields and formerly cultivated sites;
- ◆ Wooded swales dominated by Oregon ash with scattered shrubs and a diversity of herbaceous species; and
- ◆ Roadsides and ditch banks.

This species may tolerate a limited amount of ground disturbance, but it is unlikely to tolerate frequent or excessive disturbance over consecutive years. The disposal sites under consideration including the previously used dredged material disposal sites and agricultural lands would not provide suitable habitat for this species. Therefore, the alternatives would have no effect on this species.

6.8. Socio-Economic Resources

6.8.1. Economic Impacts

The proposed channel improvement alternative is not expected to change the type or quantity of goods shipped on the Columbia nor result in a shift in the type or size of vessels on the river. However, the national transportation cost savings attributed to the proposed alternative would allow vessels calling lower Columbia River ports to take advantage of more efficient loading, reduced delays and larger cargo loads from existing and expected larger vessels.

The proposed ocean sites could adversely affect commercial fishing activities off the mouth of the Columbia River by impacting the following: commercial navigation routes, fishing gear, and harvest. Navigation hazards have the potential to occur due to mounding. Significant and persistent mounding can result in adverse wave conditions causing a potentially hazardous situation to navigation. The primary management concern at the proposed ocean sites is to avoid mounding at the sites. Bathymetric surveys would be taken routinely to insure this hazard does not occur. The proposed ocean sites were selected to minimize mounding by managing disposal practices to be dispersive and to avoid the commercial navigation routes provided by the commercial fishermen. Disposal operations could directly impact crab fishing by burial of crab pots, cutting of crab lines, or restricting crabbing areas. Coordination with local fisherman groups and publishing site locations in the *Notice to the Mariners* should help prevent these problems. There is expected to be an overall reduction to damaged or lost gear, in that the proposed deep water site avoids areas that the fisherman indicated were important fishing areas.

Commercial fishermen have expressed concern with disposal burying crabs and alteration of habitat. The proposed ocean sites are located in an area that supports a variety of pelagic and demersal fish species as well as shellfish including Dungeness crab. Ocean disposal would impact commercial crab fishing to some extent off the mouth of the Columbia River. Ocean disposal site E is near the navigation route that crab fisherman take to the northern fish grounds. Disposal at site E could cause navigational hazards for these boats if the depth of sediment is not monitored. A comprehensive bathymetric monitoring program is currently planned at site E to ensure that mounding would not occur. The new deep water site, though partly located in an area where crab fisherman have agreed not to fish because of tow boat use, would affect those fisherman who choose to fish in this area regardless of lost gear. Loss of resources in this area by continued disposal may also have some effect on landings in other areas. This area, however, is relatively small compared to the entire area off the Columbia River and the impact to the total population of crabs by using the deep water ocean disposal site would be very small. Other commercial fisheries occur too far offshore or in areas that would not be impacted by disposal. Recreational fishing in the off shore area of the Columbia River is primarily for salmon and bottom fish. Neither of these fisheries is expected to be impacted by the use of the deep-water ocean disposal site since these fisheries do not occur to any extent near the site.

6.8.2. Land Use

Dredged material disposal actions associated with project construction, operation and maintenance actions entail the use of a mixture of land and water disposal sites. Disposal sites proposed for use may entail existing and/or new disposal sites (table 6-2). Land use practices at proposed disposal sites vary. In-water disposal typically would occur in or adjacent to the navigation channel, at Harrington Sump and offshore.

Table 6-2. Disposal Site Comparison

Type of Disposal	No Action Alternative		Least Cost Alternative		Proposed Alternative	
	Acres	# Sites	Acres	# Sites	Acres	# Sites
* Existing Upland	1,165	18	1,446	25	1,445	25
* New Upland	N/A	N/A	299	5	236	4
Open Water, Unrestrained	Unlimited		Unlimited		Unlimited	
Beach Nourishment	151	1	179	2	190	3
Designated Open Water	N/A	1	N/A	1	N/A	1
*Gravel Pit (Upland)	N/A	N/A	N/A	N/A	45	1
Ocean		2		2		2
Total (*Upland only)	1,165	18	1,745	30	1,681	29

6.8.2.1. No Action Alternative

The no action alternative is described in the DMMP. In summary, the no action alternative would use 18 existing upland (1,165 acres), one beach nourishment, one designated open water, and two open water unrestrained disposal sites (table 4-1). No new upland disposal sites were proposed in the DMMP. Land use practices at dredged material disposal sites proposed for use in the DMMP would be essentially unchanged.

6.8.2.2. Least Cost Disposal Alternative

This plan would use 25 existing or previously used upland dredged material disposal sites encompassing 1,446 acres (table 6-2). Eleven of the 25 existing sites are different than those proposed in the DMMP. Typically, most existing dredged material disposal sites are not used for other purposes, except as borrow sites for sand. Three exceptions in the least cost disposal plan are site O-105.0, which is proposed for industrial development; site W-97.1, which is a commercial sand/gravel operation; and Austin Point, which is presently used as a heavy equipment training school. Five new upland disposal sites encompassing 299 acres are proposed in the least cost disposal plan. These 5 sites are currently used for agricultural production, principally row crops, caneberries, and forage crops. Zoning, with one exception, is for agricultural purposes at the new locations proposed for disposal. Site W-62.0, although currently used for livestock grazing, is zoned for industrial development and has been annexed into the City of Longview. The two beach nourishment locations are currently used for dredged material disposal.

6.8.2.3. Proposed (Sponsor's Preferred) Disposal Alternative

The proposed disposal plan would utilize 25 existing upland disposal sites encompassing 1,445 acres (table 6-2). Four new upland disposal locations are proposed under the proposed plan. Three sites, W-96.9, W-62.0 and W-44.0 are also considered under the least cost plan. Gateway 3 on Port of Vancouver lands, represents a new upland site unique to the proposed plan. Gateway 3 is currently used for row crop and cereal grain production. The land is zoned for industrial development and is addressed in the Port of Vancouver's *Master Plan for Development*.

6.8.2.4. Prime and Unique Farmlands

The Farmland Protection Policy Act (Subtitle I of Title XV of the Agriculture and Food Act of 1981), as implemented under the Department of Agriculture's final rule effective August 6, 1984, requires the Corps to contact the Natural Resource Conservation Service for identification of prime or unique farmland potentially impacted by Corps actions. The Corps is required to examine the potential impacts of the proposed action, and if there are adverse effects on farmland, to consider alternatives to lessen the adverse effects. It is within the Corps discretion to proceed with a project that would result in conversion of farmland to nonagricultural uses once the required examination has been completed. The focus on upland disposal of dredged material arising from the proposed channel improvements would result in impacts to prime and unique farmlands. Existing upland disposal sites targeted for use have a history of dredged material disposal and are typically located along the Columbia River shoreline. Wildlife mitigation requirements for upland disposal and ecosystem restoration measures would also impact prime and unique farmland. Impacts to prime and unique farmland vary by the alternative considered and the disposal plan selected under a particular alternative.

The no action alternative would not require the use of new upland disposal sites. Existing disposal sites along the Columbia River would be used for disposal of dredged material. Therefore, this alternative would have no effect on prime and unique farmlands.

The two disposal alternatives were evaluated for implementing the 43-foot channel deepening alternative. Acreage of prime and unique farmlands impacted by upland disposal under either disposal alternative varies by both county and state. Total agricultural acreage impacted by the least cost disposal alternative is estimated at 290 acres in three Washington counties and one Oregon county. The proposed disposal plan would impact an estimated 227 acres of agricultural lands in Washington.

The least cost disposal plan would impact an estimated 183 acres of farmlands at four locations in Washington by upland siting of disposal sites. Thirty-three acres of farmland would be impacted in Clark County in the Vancouver Lowlands. Fifty acres of farmland would be impacted by disposal in Cowlitz County at the Mt. Solo property (W-62.0) immediately downstream of Longview, Washington. One hundred acres would be impacted in Wahkiakum County in one parcel located near the ferry terminal on Puget Island. An estimated 107 acres of farmland would be impacted in Oregon by upland disposal actions. The proposed 107-acre disposal site is located on an active dairy farm in the Scappoose bottomlands near the Scappoose Airport.

The proposed disposal alternative would impact 77 acres of agricultural lands in Clark County at Gateway 3 and W-69.9. The Mt. Solo property (50 acres) and the Puget Island property (100 acres) are also included in this disposal alternative. No practicable alternative upland disposal locations are available within the project area. All available land areas suitable for disposal sites are considered prime and unique farmlands.

Wildlife mitigation actions to offset impacts associated with the least cost disposal alternative also would result in the conversion of farmland to wildlife habitat. An estimated 418 acres of agricultural land in Cowlitz County would be converted from pastureland and row crop agriculture to wildlife habitat. These 418 acres are located on Martin Island and adjacent lands in the Woodland bottoms. Approximately 190 acres of agricultural pasturelands in Oregon would be converted to wildlife habitat with implementation of the mitigation plan. The use of agricultural lands in Oregon would occur near Westport (190 acres) in Columbia County. Conservation measures, implemented under the Endangered Species Act, would result in 112 acres of agricultural lands on Puget Island being managed for Columbian white-tailed deer.

Mitigation actions implemented for the proposed plan would also result in impacts to prime and unique farmlands in Washington and Oregon. Wildlife mitigation requirements would encompass 418 acres in Washington and 74 acres in Oregon. Martin Island and Woodland bottoms are the parcels proposed for wildlife habitat development in Washington. The Westport agricultural parcel would be proposed for wildlife habitat development. Additionally, 116 acres near Westport would be managed for Columbian white-tailed deer as a Conservation Measure under the ESA.

In addition, three ecosystem restoration actions are under consideration for implementation. Only one action, the restoration of Shillapoo Lake, would impact prime and unique farmland. Approximately 1,248 acres of agricultural lands would be managed for wildlife habitat purposes at this location. The conversion of Shillapoo Lake to wildlife habitat management represents the proposed action under the acquisition and management plans being pursued by the WDFW for the lake.

6.8.3. Air Quality

Implementation of a channel improvement alternative would generate more pollution from dredge and commercial ship engine exhaust than current practices. Portland is classified as a "maintenance area" under Section 175A of the Oregon Clean Air Act. The emission standards for maintenance areas from direct and indirect emissions are 100 tons per year for ozone, carbon monoxide, and particulate matter. Direct emissions would apply to exhaust from dredging required to deepen the navigation channel. Using emissions data from the Corps dredge *Essayons* and estimating dredging time for channel deepening in the Portland area, total direct emissions are estimated at 40 tons per year for ozone, 4 tons per year for carbon monoxide and 1.2 tons per year for particulate matter. This is well below the standards.

. The continued contribution of the navigation channel to the commerce of the region may have some secondary effect on the air quality of urbanized areas. Increased upland disposal may contribute added airborne particulate in local areas adjacent to these sites. Adverse effects on human health from this source are unlikely as most are removed from populated areas. Disposal sites, which may have an effect on local residents, can be evaluated on a site by site basis and stabilization measures can be implemented as needed.

6.8.4. Noise

Noise levels vary in proportion to the level of urban development within each reach. Noise associated with channel dredging include hopper dredge operation, pipeline dredge operation, and operation of earth-moving equipment at upland disposal sites. Hopper dredge operations are usually below noise levels of other ships and barges transiting the river. Pipeline dredges create short-term noise increases when setting up and during the pumping operation. Noise levels rarely exceed background levels in urban areas. Earth moving equipment would exceed background levels for short periods of time during disposal site preparation.

6.8.5. Aesthetics

Aesthetic impacts result principally from upland and shoreline disposal practices. The effect of continuing existing disposal practices would be to maintain the visual appearance of sandy beaches at the remaining shoreline disposal sites and constructed sand disposal sites at upland sites. All alternatives being considered would reduce shoreline disposal sites and increase use of upland disposal sites. Existing upland sites would receive more dredged material than present practices and some sites would increase in height by as much as 45 feet. Shoreline sites not receiving additional dredged material would eventually erode to their original bankline. The alternatives would result in an obvious change in visual appearance at some sites, and, in some cases, affect the view of the river by local residents.

6.8.6. Recreation

Recreation impacts resulting from deepening the navigation channel would occur primarily from the initial construction activities affecting recreational fishing near the new dredging and disposal locations. Otherwise, impacts from maintenance of a deeper channel should not differ significantly from the ongoing 40-foot channel maintenance.

6.8.7. Cultural Resources

Many of the islands adjacent to the channel contain temporary camps used by Native Americans indigenous to the lower Columbia River area (Gilbow et al, 1981). A survey of this area did not locate these sites. The most likely historic cultural resource within the study area would be shipwrecks. No shipwrecks are reported within the vicinity of the navigation channel. The historic salmon fishery includes sites on Welch and Tenasillahe Islands. Facilities related to this activity include docks and temporary fishing camps constructed on the northern beaches of these islands (Gilbow et al., 1981). A cultural resource survey of these islands did not, however, document the presence of these fishing stations (Gilbow et al., 1981).

In many places further down river, such as Desdemona Sands, salmon were caught using nets pulled by horses. Facilities to keep the horses, nets, and houses built by fishermen on piers over areas were inundated during high tides. This method of catching salmon is not documented in the navigation channel. Fish traps and wiers were documented along the

shoreline of Tenasillahe and Hunting Islands (Gilbow et al., 1981). These sites are not within the area of impact.

The nearest site listed on the National Register of Historic Places is the town of Skamokawa. The town was listed based on its history as an early fishing and logging community and for its period houses and structures. The town of Skamokawa is outside of the area of proposed dredging; no impacts to Skamokawa are expected.

A cultural resources inventory was carried out on the following dredged material disposal and mitigation sites (Minor and Musil, 1998). The inventory involved a literature search for information about previously recorded cultural resources, followed by an intensive field survey by a team of archaeologists. Surveys were conducted on the sites and were supplemented by excavation of auger probes for site discovery purposes, if needed.

Gateway 3 disposal site (W-101.0). This site is located between Vancouver Lake and the north shore of the Columbia River in Washington. The southwestern portion of the site is covered by deep deposits of dredged sands, and the northeastern portion consists of farmed fields and grassy pastures that have not been covered by dredged material. No evidence of cultural resources was found during the survey. Seven auger probes placed along the bank of an abandoned slough also did not yield any evidence of cultural resources.

Adjacent Fazio disposal site (W-96.9). This site is located about 2.4 miles north of the Gateway 3 site, and is a grass-covered field. Ground visibility was low due to heavy grass cover. Bare soil was visible only in a few rodent back-dirt piles and in the lower southwest corner of the field. The nature of the exposed sediments suggests that this parcel has been covered by dredged material. No cultural resources were observed during the field survey.

Martin Island mitigation site. This site is located about 4 miles upstream from Kalama in Washington, and includes a large harbor on the east side. The island is divided down the middle by a high natural levee. To the west of the levee are low grass-covered fallow fields, and to the east are a series of tree and brush covered sloughs and levees. Ground visibility across the island varied from zero to 50 percent in the interior, and was 100 percent along the shoreline. No cultural resources were observed during the site survey.

Mt. Solo disposal site (W-62.0). This site is located on the southwest margin of Longview in Washington. It has been heavily disturbed by the erection of powerline towers in the southeast corner, and rocky fill has been deposited across the northern one-third of the site. The central and southern portions of the property were covered by dense vegetation. Except in the disturbed portion which had been stripped of vegetation, ground visibility across the site was non-existent. The parcel is low in elevation and standing water was present in some areas in the southern and central portions of the site. No evidence of cultural resources was observed during the survey of the site.

Webb Drainage District mitigation site (CRM-47.0). This site is located about 3.6 miles east of Westport, and is situated on a bend of Westport Slough on the Oregon side of the

Columbia River. The terrain is low-lying and protected by levees, and for the most part is currently used as a pasture. No evidence of cultural resources was observed on this site.

Port Westward disposal site (O-54.0). This site is located about 4.8 miles northeast of Clatskanie in Oregon, and has been considerably altered by various developments over the last century. Ground visibility across the entire property was obscured by dense vegetation cover. Only two small sections were relatively undisturbed landforms, and were very low wet areas covered by thick vegetation and standing water. Other sections of the site have recently been used as tree farms, which caused heavy disturbance to the ground surface. No evidence of cultural resources was observed during the survey of the site.

The literature search identified two prehistoric archaeological sites that occur in proximity to two of the properties. The Whill Wetz site is situated along the northeast margin of the Port Westward site but is at least 200 meters northeast of the portion of the property examined during the field survey. Five auger probes placed to the south and west of the site did not encounter any cultural deposits. This indicates that the Whill Wetz site does not extend into the portion of the Port Westward property examined for the proposed channel improvement project.

The Ede site is a prehistoric settlement discovered during construction of a dike along the shore of Multnomah Slough on the southeast margin of the Scappoose Dairy site. It is possible that prehistoric cultural deposits associated with the Ede site extend inland under the dike and onto the Scappoose site. In the event that the Scappoose site is used for the proposed project, archaeological testing should be conducted to determine if the Ede site would be affected.

In summary, no cultural resources were identified on any of the sites surveyed. Aside from possible subsurface testing on the Scappoose Dairy site as suggested above, no further field work is recommended for the sites examined for cultural resources in connection with the proposed channel improvement project.

6.9. Secondary Impacts

Secondary impacts which may be attributed to deepening the navigation channel include increased bankline erosion from ship wakes; increased likelihood of introducing non-indigenous species; additional dredging requirements at port berthing areas; increased ship traffic; and increased development of port facilities.

As stated in Section 6.2, distinguishing bank erosion caused by ship wake from other causes such as wind generated waves and river currents is impossible to estimate. It is known that ship wakes currently contribute to a percentage of bank erosion on the lower Columbia River. Also, ship size and speed contribute to the height of the wakes, and speed is a greater contributing factor than ship size. Channel deepening could lead to some increase in use by larger ships but ship traffic and commodity projections indicate that larger ships currently transiting the Columbia River would fully load given a deeper channel (see Sections 3.3 and 4.5). Even if deeper draft vessels and more transits would

occur on the Columbia River, there would be no measurable increase due to ship wake erosion.

Introduction of non-indigenous species through ship ballast water has been an ongoing problem at nearly all U.S. deep draft ports. Several aquatic and non-aquatic species have entered the Columbia River system from a variety of sources. One of the known aquatic species which has entered the Columbia River is the Asian clam, *Corbicula*. This is not considered a "nuisance" species and is now an important food source for juvenile salmonids. Authority for management and regulation of exotic species through ship ballast water resides with the U.S. Coast Guard. The Corps currently monitors for presence of the introduced zebra mussel at upstream Columbia River dams. No zebra mussels have been found to date. Deepening the navigation channel would not likely cause an increase in exotic species since any increase in number of ships is dependent on demand for commodities, with or without a deeper channel. It is likely that, over time, commodity demands and subsequent increase in shipping would lead to increased opportunity for introduction of non-native species, again with or without a deeper channel. The interagency aquatic nuisance species task force will continue to pursue efforts to minimize further introduction of species.

Deepening the federal navigation channel would require modification of port access channels and berthing areas. The local ports that would benefit from a deepened navigation channel would be required to deepen berthing areas for deeper draft vessels. The ports would be required to obtain dredging permits for these activities. The benefited berthing areas expected to be deepened include the following.

- The Port of Astoria plans to remove about 46,500 cy.
- The Port of Kalama plans to remove about 250,000 cy.
- The Port of Portland estimates a total of about 600,000 cy to be removed from three berthing areas.
- The Port of Longview plans to remove about 28,000 cy.
- The Port of Vancouver plans to remove about 250,000 cy.

The ports have sampled sediments in these areas. The results of the most recent sampling are contained in Appendix B. If, as a result of testing required before actual dredging, it turns out that the material is not suitable for in-water disposal, it will be disposed of in a manner to avoid unacceptable environmental impacts.

Potential impacts would include disturbance of benthic habitat within the areas to be dredged; resuspension of contaminated sediments at the dredging sites; and potential biological and/or water quality impacts from disposal actions. Benthic habitat at port berthing areas is not considered high value because of the depth at these sites and intermittent disturbance from dredging and ship propeller wash. Contaminated sediments are known to occur in the vicinity of Port of Portland berthing areas. Further evaluation of these sediments would be required to determine appropriate dredging and disposal methods pursuant to the *Dredged Material Evaluation Framework, Lower Columbia River Management Area, November 1998*.

As previously stated, channel deepening in itself would not induce additional ship traffic. The primary benefit of a deeper channel would be from allowing existing deeper draft vessels to depart fully loaded. Likewise, it would not contribute to development of additional ports or port facilities. Commodity demand is the primary economic factor contributing to these increases. More or less demand for goods shipped from the lower Columbia River ports would occur with or without a deeper channel. Based on the economic analysis conducted for this study, a deeper channel would help maintain the competitive position of the Columbia River ports.

6.10. Mitigation

Initial mitigation efforts centered upon avoidance and minimization of impacts to wildlife habitat, to the extent practicable, during selection of dredged material disposal sites. Avoidance was accomplished by focusing disposal siting efforts on existing and previously used disposal sites. The application of environmental criteria (Section 4.4.3.4) was used to avoid sites with wetland and riparian habitats or important wildlife resources to the extent practicable. Adjustment of disposal site boundaries to avoid riparian and wetland habitat, based upon site visits and review of aerial photography, was also employed. Minimization was employed by essentially stacking dredged material higher on individual sites rather than expanding a site's footprint. Where avoidance and minimization measures were impracticable, resulting in selection of disposal sites that contained wildlife habitat and supported wildlife resources, compensatory mitigation actions were instigated. Compensatory mitigation is simply the restoration or development of wildlife habitat to replace those wildlife values lost due to project related actions. The wildlife mitigation plan is presented in Appendix G and details mitigative actions proposed to offset project impacts. An addendum to Appendix G addresses resource agency concerns after review of the draft EIS and identifies a proposed mitigation plan for project impacts. As noted in the addendum, the mitigation plan will be reviewed and adjusted further during the preconstruction, engineering and design phase of the project.

Mitigation actions address a number of significant wildlife resources and habitats. Riparian habitat mitigation will provide habitat for ESA listed species, principally bald eagles, but also provide critical habitat for Snake River salmonids. Migrant birds, protected by the Migratory Bird Conservation Act and the Migratory Bird Treaty Act, including neotropical migrants that are a focus of the national/international Partners in Flight conservation actions, will also benefit from development of riparian and wetland habitat with mitigation implementation. Wetland habitat development will benefit many waterfowl species. Waterfowl are the focus of local, regional and national efforts under the North American Waterfowl Management Plan directed at habitat restoration and population recovery and maintenance. Cackling and dusky Canada geese, for which management efforts in the Pacific flyway are focused toward their recovery to identified population levels, would benefit from the development of wetland and permanent winter forage habitat described in the mitigation packages.

To determine compensatory mitigation levels, an interagency wildlife mitigation team was formed. The team consisted of representatives from the Corps, FWS, ODFW, WDFW, and WDOE. The FWS's HEP process was selected as the analytical means to assess project related wildlife impacts and mitigation attainment levels. The HEP process assesses both habitat quality and quantity for target species selected by the HEP team. Target species are selected as representative members of the habitats present in the area of impact. Three basic habitats, wetlands, riparian and agricultural, are potentially impacted by disposal actions. The target species selected for analysis of project related impacts were: pond-breeding amphibians, Canada goose, mallard, savannah sparrow, Cooper's hawk, black-capped chickadee, yellow warbler, mink, and song sparrow. Habitat variables important to each species, methods to measure these variables, and species models which assign suitability indices (numerical scores) to habitat variables are identified. Existing HEP models were generally used in this process, modified by the interagency team where necessary, along with development of one new model.

The HEP analysis initially focuses on determination of impacts from project actions. Habitat quantity was determined by mapping habitat acreage for each new upland disposal site. Riparian and wetland habitat that occurred within the boundaries of existing or previously used disposal sites was included in the loss assessment phase of HEP. Habitat quality was determined by field sampling of species specific habitat variables at representative locations. Field data were summarized and species suitability indices for individual habitat variables were then identified. Mathematical equations were then used to determine habitat suitability indices, a quality value, for each species. Multiplication of habitat quantity and habitat suitability indices on a species-specific basis then provides the number of habitat units lost per species. Species losses are reported as average annual habitat units (AAHUs), which is an estimate of the average number of habitat units lost per year over the project life of 50 years.

The mitigation phase of the HEP analysis focuses on determination of the level of recovery associated with proposed mitigation actions. Initially, a number of mitigation sites were identified along the entire reach of the Columbia River encompassed by the project. Mitigation sites were generally selected on the basis of large tracts of land with potential for habitat development and their nearness to national wildlife refuges or state wildlife management areas. Several sites identified by individuals during the course of public meetings were also given consideration. These potential sites were then analyzed to determine their baseline value to wildlife and the incremental increase in wildlife habitat value that can be attained through implementation of wildlife mitigation measures.

Existing habitats at potential mitigation sites were identified and quantified to determine the baseline condition for each site. Physical measures that could be employed at each site to develop riparian, wetland or agricultural habitat features were then identified and quantified. Habitat quality for target species was determined for mitigation sites as described for disposal sites; projections for future habitat conditions are made for each habitat developed through implementation of mitigation actions. Future projections were based on field sampling of habitat variables in representative habitats and professional

judgment. The accumulated information was then analyzed to determine the number of AAHUs generated at each site by the proposed mitigation measures.

Once information on project related losses and mitigation gains were identified, a determination of the number of mitigation sites required to offset losses was determined. The selection of which mitigation sites to use was determined by cost efficiency and incremental cost analyses per output. These analyses are intended to assure that the least expensive, most cost efficient mitigation measures are employed.

6.10.1. No Action Alternative

No compensatory mitigation measures were necessary for this alternative as disposal site selection focused on use of existing dredged material disposal sites and avoidance of riparian and wetland habitat.

6.10.2. 43-foot Channel Deepening Alternative

Mitigation actions for the channel improvement alternative are associated with the two disposal alternatives, the least cost and proposed (sponsor's preferred) plan.

6.10.2.1. Least Cost Disposal Alternative

Implementation of the least cost disposal plan would require mitigation of wildlife habitat losses at 13 disposal locations. The emphasis on avoidance of wetland and riparian habitat during the selection process for disposal sites resulted in the majority of habitat impacts encompassing agricultural lands. An estimated 285 acres of agricultural lands would be lost due to dredged material deposition. Agricultural lands impacted by disposal actions are principally pasturelands and cereal grain/row crop fields. This habitat is probably most important to wintering waterfowl, particularly Canada geese, but also provides habitat for many other species depending upon crop grown, grazing pressure by cattle, management practices and other factors. The agricultural loss acreage includes 28 acres identified as farmed wetland; these locations are sites that in the absence of agricultural management practices (e.g., tillage, drainage) would convert to wetland habitats.

Riparian habitat losses were estimated at 67 acres. Thirty-two acres of riparian habitat losses were early successional stage riparian forest representing cottonwood trees pioneering onto dredged material disposal sites that had been idle for 10 years or greater. Twenty-six acres of riparian forest at O-64.8 and O-63.5, represented by cottonwood dominated forests 25-50 plus years of age would be impacted by disposal. The balance of riparian habitat impacted would be small inclusions of riparian trees, degraded by cattle grazing, located in otherwise agricultural settings.

Wetland habitat losses were estimated at 28 acres. These losses occurred at three locations and include wetland habitat associated with drainage ditches, land subject to row crop agriculture, and land grazed lightly by livestock.

The HEP analysis, with AAHUs adjusted to discount bias associated with a different number of target species per habitat classification, indicated a project-related loss of 659 AAHUs. A five percent contingency factor was included to account for habitat losses associated with pipeline right-of-way impacts and drainage channels. Thirteen potential mitigation sites were initially identified. Preliminary cost estimates were developed for these 13 locations based upon conceptual mitigation measures. Based upon initial results of the impact analysis, it was estimated that 9 potential mitigation locations could potentially offset project-related losses. The nine least costly locations were thus selected for further analysis. More detailed mitigation plans were developed for these 9 locations, acreage for each habitat developed was quantified, and cost estimates were developed. These sites were then subjected to HEP analysis to determine AAHUs produced per site. Once production and costs per AAHU were determined, incremental cost and cost efficiency analyses were performed in order to select the most cost efficient selection of mitigation sites that produced sufficient AAHUs to offset project losses.

Three sites, Woodland Bottoms (CRM 81), Martin Island (CRM 80), and Webb (CRM 47), encompassing 852 acres, were determined to produce sufficient AAHUs (754) to offset project related losses (659 AAHUs) associated with implementation of the least cost disposal alternative (table 6-3). Mitigation management actions would entail use of 743 acres of the total acreage on these three sites. Wetland habitat development or improvements would occur on 236 acres. Riparian habitat development or improvement would encompass 396 acres. Agricultural management, such as permanent pastureland, would occur on 111 acres.

The Woodland Bottoms location would produce 291.9 AAHUs derived from wetland, riparian and agricultural crop production for wildlife (permanent pastureland for Canada goose forage). Ninety-seven acres of wetland habitat would either developed or improved. Removal of cattle from the existing wetland habitat would result in the majority of wetland habitat gains. Riparian forest would be planted on 44 acres. Permanent pastureland would be planted on 132 acres.

Table 6.3. Mitigation for the Least Cost and Proposed Disposal Alternatives.

Mitigation Site	Least Cost Disposal Plan Mitigation			Proposed Disposal Plan Mitigation		
	Mitigation Site Acreage	Mitigation AAHUs	AAHUs Lost	Mitigation Site Acreage	Mitigation AAHUs	AAHUs Lost
Washington						
Woodland Bottoms	284	291.9		284	291.9	
Martin Island	378	223.8		378	223.8	
Washington Total	662	515.7	-366.4	662	515.7	-352.9
Oregon						
Webb	190	238		74	92.7	
Oregon Total	190	238	-292.9	74	92.7	-92.4
Grand Total	852	754	-659.3	736	608.1	-445.3

Riparian and wetland habitat development at Martin Island would produce an estimated 223.8 AAHUs. Removal of cattle grazing and riparian plantings would result in 244 acres of riparian habitat at Martin Island. Filling an embayment and improvements to an existing wetland would provide 39 acres of wetland habitat at Martin Island. The existing embayment was excavated in the early 1970s in order to provide fill material for a nearby section of Interstate 5. The proposed mitigation action would utilize construction and maintenance material from the navigation channel to fill the embayment to a level in the lower intertidal range. Soil from overburden cast aside from the original embayment excavation would be placed atop the sand fill for a growing medium for emergent marsh vegetation. Recreational and/or log raft moorage would be lost with embayment development for mitigation purposes.

The Webb location near Westport would produce 238 AAHUs from wetland and riparian forest management. Improvements and development would produce 100 acres of wetland habitat. Riparian forest plantings would encompass 87 acres.

6.10.2.2. Proposed (Sponsor's Preferred) Disposal Alternative

Mitigation requirements for the proposed disposal alternative are less than those for the least cost alternative (table 6-3). This reduced requirement results from the use of fewer new upland disposal sites. This plan replaces several upland disposal sites proposed in the least cost plan with disposal in an existing gravel pit. One new upland site located on Port of Vancouver land in the Vancouver Lowlands also is proposed.

Implementation of the proposed disposal plan would impact an estimated 200 acres of agricultural lands, 67 acres of riparian forest and 20 acres of wetlands. Agricultural lands impacted are used for row crop/cereal grains or pastureland. Values for wildlife were noted in the discussion of mitigation for the least cost plan. Riparian habitat losses were identical to site and seral stage as the least cost plan with minor acreage additions included for pipeline access routes to the gravel pit locations. Wetland losses were at two locations, W-62.0 and W-44.0; both sites were discussed in the least cost disposal plan.

The HEP analysis, with AAHUs adjusted to discount bias associated with a different number of target species per habitat classification, indicated a project-related loss of 445 AAHUs. A five percent increase in AAHUs lost was included in the loss total to account for habitat losses associated with pipeline right-of-way impacts and drainage channels. Mitigation sites were examined once again relative to least cost and cost effectiveness to determine the most cost efficient locations for mitigation of wildlife resources impacted by the proposed plan. Three sites, Woodland Bottoms, Martin Island and Webb (74 acres) were identified as the best locations for cost efficient mitigation actions. These locations would provide 608 AAHUs of output with implementation of mitigation actions. Mitigation outputs by habitat category were identified in the mitigation section for the least cost disposal plan.

The proposed plan for mitigation is typically based upon the selection of the most cost efficient, incrementally justified mitigation actions. Societal/political considerations may result in selection of different mitigation actions. Local opposition or an owner's refusal to sell could lead to selection of different mitigation locations. Port and resource agency representatives have both voiced their reluctance to purchase and manage/administer controversial sites.

The proposed disposal plan would result in a loss of 353 AAHUs in Washington and 92 AAHUs in Oregon. The other mitigation plans discussed previously would result in the most AAHUs occurring for those species associated with wetland and riparian habitat. Again, because wetland and riparian habitat would be developed on lands currently in some form of agricultural use, Canada geese and savannah sparrows would incur additional losses in AAHUs.

6.11. Unavoidable Adverse Impacts

Deepening the navigation channel (proposed plan) would impact benthic and fisheries habitats not previously disturbed by dredging. Disposal of dredged material would adversely affect additional in-water and upland areas, including 200 acres of farmland, 67 acres of riparian woodlands and 20 acres of wetlands. As described in the preceding section, these habitat losses would be replaced through mitigation actions. Additional wetland and riparian habitat would be restored through the proposed ecosystem restoration actions. Ocean disposal would occur at new and larger disposal sites, which would adversely affect marine resources at those locations.

6.12. Cumulative Impacts

Cumulative impacts are defined by the Council on Environmental Quality (CEQ) guidelines as "... the impact on the environment which results from the incremental impact of the proposed action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions."

Habitat losses from past actions along the lower Columbia and Willamette Rivers have been considerable. The vast majority of these habitat losses are attributed to actions not related to the navigation channel such as diking for agricultural development or filling for urban developments. Studies conducted by Graves et. al. (1995) indicate a total loss of 51,997 acres of wetland/marsh habitat and 27,004 acres of forested wetland habitat since the 1880s (table 2-3). Much of the wetland loss can be attributed to the nearly 84,000 acres encompassed by diking districts and/or a 20,000 acre increase in urban development that has occurred since that time. The combination of diking, urban developments and dredged material disposal practices have essentially contributed to the narrowing of the river and reduced floodplain and floodplain habitats. Port developments and related infrastructure development such as roads and railroads have further contributed to habitat degradation. Continual maintenance dredging of the navigation channel and associated port access channels have resulted in reduced habitat value for aquatic species.

Habitat impacts over the past 20 years have been estimated through a review of 1974, 1989 and 1996 aerial photography. This review addressed the 82 upland and/or shoreline disposal sites used for disposal during that time period. Estimates for riparian and/or wetland habitat, shallow water habitat, agricultural lands, industrial sites, existing disposal sites and areas unaffected by disposal were estimated for these 82 sites. Existing disposal sites accounted for an estimated 2,696 acres of the total. Impacts to riparian/wetland habitat were estimated at 898 acres. Port of Kalama industrial development actions which used dredged material for fill accounted for 420 acres of the riparian/wetland impacts; mitigation plans were implemented for Port of Kalama development actions. Emergency dredging actions associated with the Mt. St. Helens eruption accounted for an estimated 325 acres of the total riparian/wetland impacts and 220 acres of the total shallow water habitat impact. Impacts to shallow water were estimated at 749 acres. Miller Sands Spit accounted for about 76 acres of shallow water loss post-1975. Otherwise, shallow water impacts were scattered throughout the length of the project and involved relatively small acreage. Agricultural impacts were estimated at 50 acres of pastureland on Hayden Island. Industrial sites accounted for an estimated 114 acres and 88 acres were not impacted.

Future wetland/riparian habitat losses are expected to be reduced because of current state and Federal requirements under the Clean Water Act and Endangered Species Act. New programs now in place such as habitat restoration programs by the States of Oregon and Washington, the National Estuary Program, and the Corps of Engineers Ecosystem Restoration Program would potentially lead to restoration of large areas currently diked or filled to wetland/riparian habitat.

The continued reduction in shoreline disposal sites has led and would continue to lead to the natural recovery of the natural bankline along the Columbia River. The extent of natural bankline recovery that has occurred or is expected to occur has not been determined. However, recovery can be observed by examining aerial photos of former shoreline disposal sites used over time. Natural banklines provide a more hospitable substrate for the development of riparian/wetland vegetation than sandy dredged material.

Actions related to channel deepening would include: continued use of the navigation channel by deep-draft vessels carrying goods to and from Columbia River ports; continued development of port facilities to meet future needs; and contributing to the maintenance of current levels of economic and population growth in the region. If implemented, this action would lead to some further loss of habitat for aquatic and terrestrial species and lands for agricultural production.

The proposed disposal plan would impact 219 acres of agricultural lands, portions of which are wetlands. Wildlife mitigation actions associated with this disposal plan would convert 382 acres of farmland to wildlife habitat. Construction of the ecosystem restoration action at Shillapoo Lake would convert an additional 1,248 acres of agricultural lands to wildlife habitat management. Conservation measures for the ESA-listed Columbian white-tailed deer would convert approximately 111 acres of pasturelands in Webb Diking District. Total agricultural lands potentially impacted by the least cost

disposal plan are 1,960 acres. The majority of the farmland lost (1,775 acres) would occur in Washington, with the balance (185 acres) in Oregon.

Implementation of the least cost disposal plan would result in the direct loss of 290 acres of agricultural lands, including wetland inclusions, along the lower Columbia River. Wildlife mitigation actions associated with this disposal plan would convert 493 acres of farmland to wildlife habitat. Construction of the ecosystem restoration action at Shillapoo Lake would convert an additional 1,248 acres of agricultural lands to wildlife habitat management. Conservation measures for the ESA-listed Columbian white-tailed deer would convert approximately 112 acres of pasturelands on Puget Island. Total agricultural lands potentially impacted by the least cost disposal plan are 2143 acres. The majority of the farmland lost (1,851 acres) would occur in Washington, with the balance (292 acres) in Oregon.

Agricultural lands along the lower Columbia River are incurring losses from urban and industrial development plus mining for gravel resources. Either disposal plan would contribute to the cumulative loss that is occurring presently. Clark, Cowlitz, and Wahkiakum Counties in Washington incurred an 11 percent loss (15,618 acres) in all croplands from 1987 to 1992 (U.S. Department of Commerce, 1994). The 1,775 acres of croplands impacted by the proposed project would represent an additional 1.2 percent loss of cropland for a cumulative total of 17,578 acres in those three Washington counties. The least cost disposal plan figures are 1,780 acres of croplands impacted and a similar percentage loss. Obviously, urban/industrial development has resulted in additional cropland losses since the *1992 Census of Agriculture* in those Washington counties.

Multnomah and Columbia counties in Oregon experienced a four percent decline in cropland (4,197 acres) from 1987 to 1992 (U.S. Department of Commerce, 1993). It is projected that an additional 185 acres would be lost if the proposed disposal plan is implemented. This would represent an approximately 0.2 percent additional loss of croplands in Oregon and increase the total loss to 4,382 acres. The 292 acres that would be impacted under the least cost plan lead to a slightly higher loss figure. Similar to Washington, urban/industrial development would have resulted in additional losses to croplands since the *1992 Census of Agriculture*.

Riparian forest habitat losses along the lower Columbia River have been estimated by Graves et al. (1995) and the Corps of Engineers (1996) from the 1880s to 1991. An estimated 13,800 acres of riparian forest were lost during that period, principally to agricultural and urban/industrial land development. The loss of 67 acres of riparian forest associated with the least cost disposal plan represents an increase of about one-half of one percent to the estimated cumulative loss. The remaining amount of riparian forest downstream of CRM 105.5 along the lower Columbia River is estimated at 2,240 acres. Riparian acreage impacted by the proposed project represents three percent of that total. It should be noted that riparian habitat, e.g., early successional stage, that mitigation is proposed for in this plan would not be currently counted in the cumulative total of riparian habitat present along the lower Columbia River.

Riparian mitigation under the proposed disposal plan would develop and restore 202 acres of riparian habitat or 4.4 times the amount impacted. The wildlife mitigation actions proposed to offset disposal impacts for the least cost plan would develop 375 acres of riparian habitat. This is a nearly a six-fold increase over projected losses from disposal actions. The net result of project-related mitigation under either disposal plan would increase the riparian habitat acreage from existing levels along the lower Columbia River.

Wetland habitat loss is estimated at 20 and 28 acres for the proposed plan or least cost plan, respectively. Historical wetland losses along the lower Columbia River have been estimated by Graves et al. (1995) and the Corps of Engineers (1996) from the 1880s to 1991. An estimated 52,000 acres of wetland/marsh and 27,000 acres of forested wetlands were lost during that period. Mitigation actions proposed for the project would restore and or develop 202 acres (proposed plan) or 236 (least cost plan) acres of wetland habitat.

These wetland mitigation acreages represent about a 10-fold increase over projected losses and would result in a net gain of wetland habitat along the lower Columbia River. Also, the ecosystem restoration project at Shillapoo Lake would restore about 1,200 acres of wetland habitat. Potentially, project related actions could result in the restoration of over 1,400 acres of wetland habitat along the lower Columbia River.

Cumulative losses of wildlife along the lower Columbia River are directly related to the losses in wetland/marsh, forested wetland, and riparian habitat acres that have occurred over time. Implementation of the ecosystem restoration action at Shillapoo Lake will result in a cumulative gain in habitat units for wildlife species. The cumulative gain, projected across all target species analyzed at Shillapoo Lake, is 1,330 habitat units.

Ecosystem restoration actions to restore/improve anadromous fish passage at tide gates located on tributary streams would result in a cumulative improvement to about 38 stream miles of habitat. The cumulative loss of anadromous fish access into tributary streams along the lower Columbia River from all factors was not determined in this investigation. Ecosystem restoration actions to improve water quality, circulation, and benthic invertebrate and fisheries habitat at shallow water embayments would encompass 335 acres at two locations. While these restoration actions represent a cumulative gain, cumulative losses in shallow water habitat from all factors were not determined in this investigation.

6.13. Relationship Between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

Maintenance of the existing 40-foot channel is a continuation of past and present activities on the Columbia and Willamette Rivers. Many of the natural components of the river have adapted to these human use activities. Long-term biological productivity of a deeper channel (up to 43 feet) is not expected to differ significantly from that which would occur from current maintenance practices. Likewise, land use activities such as port and industrial developments, recreation activities, air quality effects, aesthetic impacts would not differ to any measurable extent over the long-term.

6.14. Irreversible and Irretrievable Commitments of Resources

The capital and labor necessary to dredge the channel and dispose of the material would be committed irreversibly and irretrievably. This includes the capital and labor associated with construction activities, administration, operations, maintenance and products and materials used. Selection of in-water sites would commit those sites for disposal of dredged material. Selection of any new or expanded upland sites would likewise commit those areas to that use. Although decisions to use these sites are reversible, it is likely that, once established, these sites would be used for the foreseeable future.